United States
Department of
Agriculture

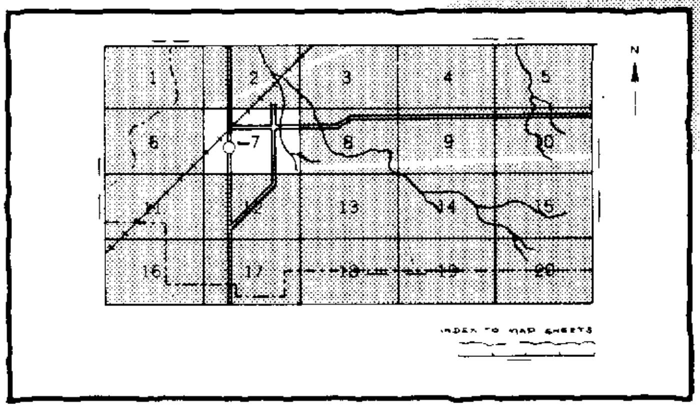
Soil
Conservation
Service

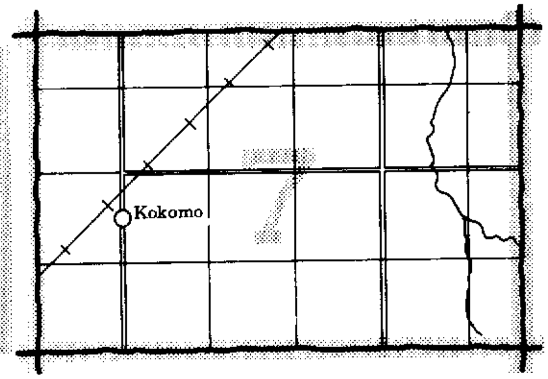
In cooperation with
University of Nebraska,
Conservation and
Survey Division

Soil Survey of Madison County, Nebraska

HOW TO USE

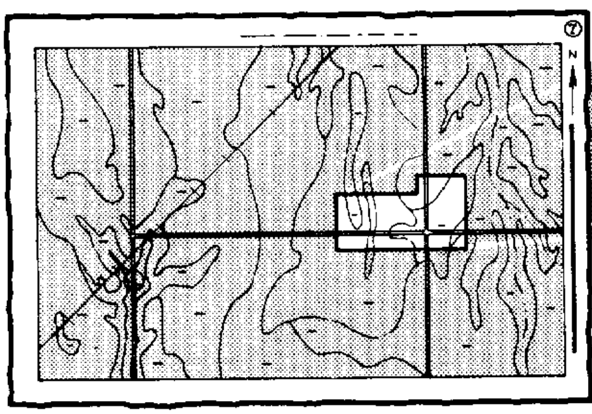
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

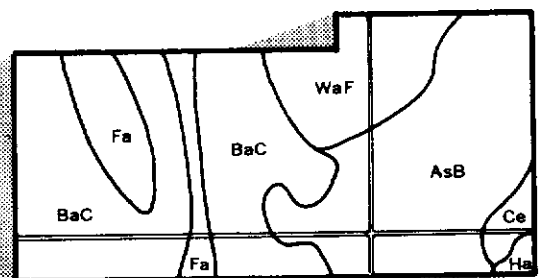




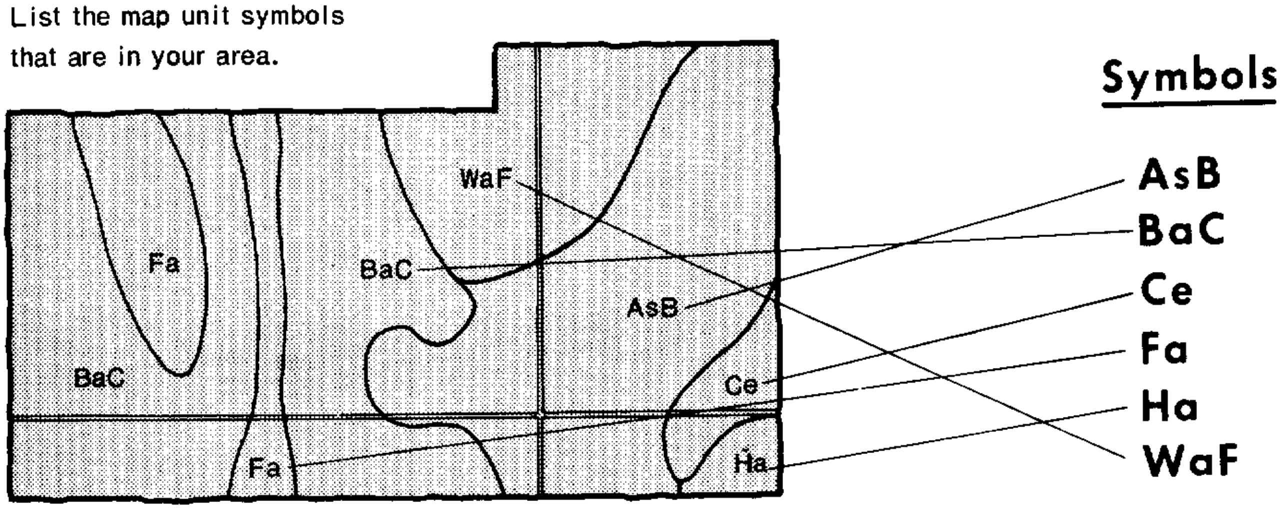
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



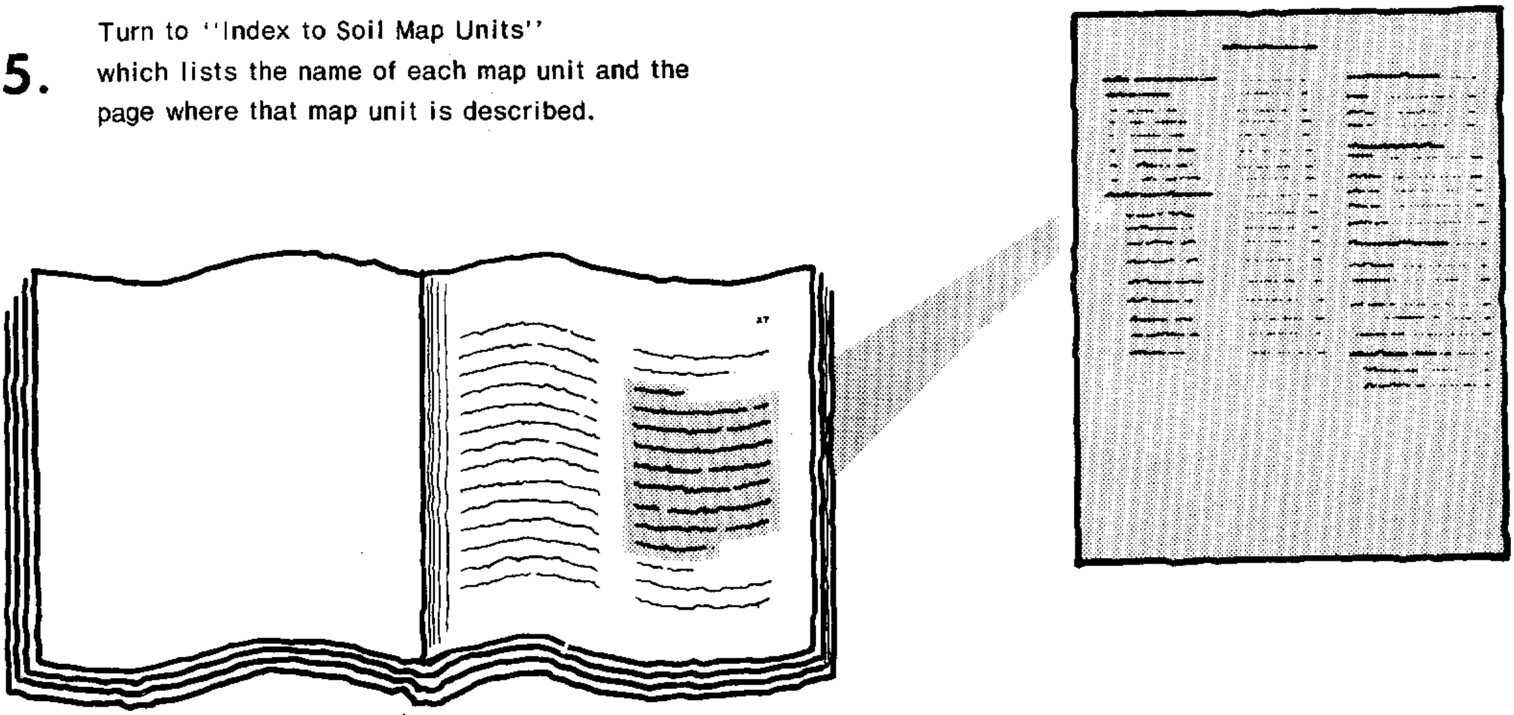


4. List the map unit symbols that are in your area.

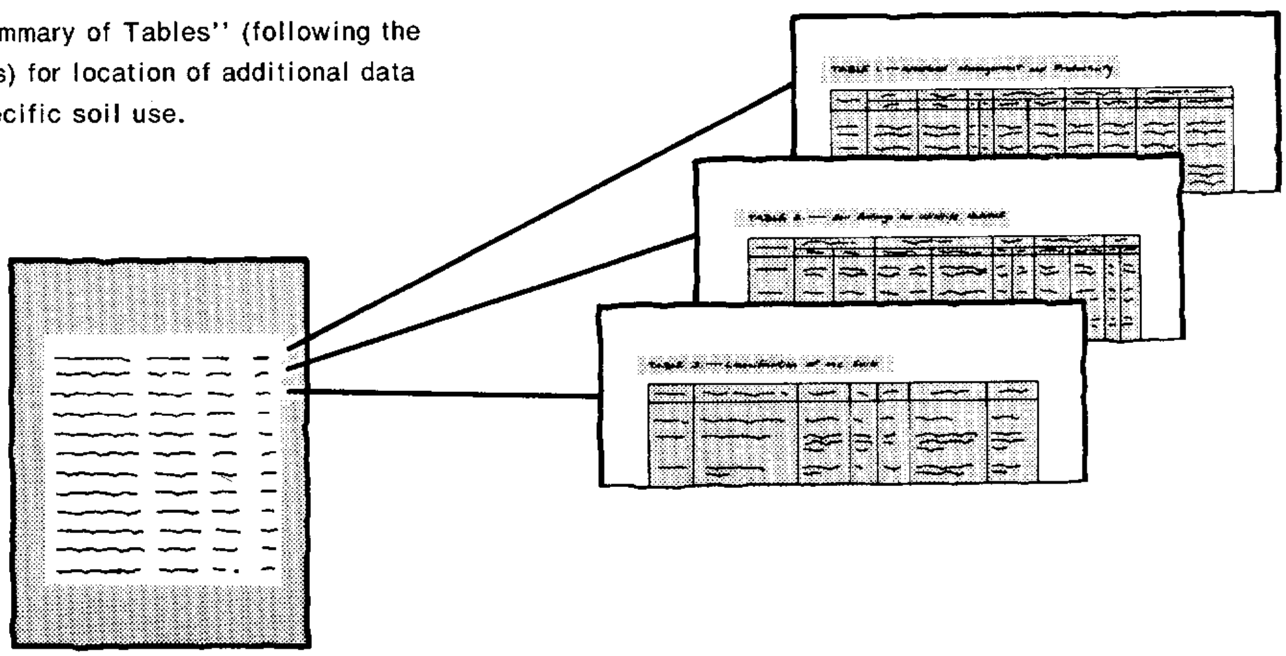


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, the University of Nebraska Conservation and Survey Division, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the Lower Elkhorn Natural Resources District. The Lower Elkhorn Natural Resources District and the Madison County Commissioners provided financial assistance for part of the mapping on this survey. Major fieldwork for this soil survey was completed in 1974-1980. Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Terraces, grassed waterways, contour farming, a farmstead windbreak, and field windbreaks in the Nora-Crofton-Moody association.

Contents

Soil Series

Issued May 1984

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Madison County, Nebraska. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service.

Sherman L. Lewis

Sherman L. Lewis
State Conservationist
Soil Conservation Service

Soil Survey of Madison County, Nebraska

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United States Department of Agriculture, Soil Conservation Service
in cooperation with
University of Nebraska, Conservation and Survey Division

MADISON COUNTY is in the northeastern part of Nebraska (fig. 1). It has an area of 575.5 square miles, or 368,326 acres. It is bordered on the east by Stanton County, on the south by Platte County, on the west by Antelope and Boone Counties, and on the north by Pierce County. Norfolk is the largest town, and Madison is the county seat. Battle Creek, Meadow Grove, Newman Grove, and Tilden are other towns in Madison County. Each community has most of the services required in a farming area.

Agriculture is the main economic enterprise in Madison County. The main crops grown in the county are corn, soybeans, alfalfa, grain sorghum, oats, and other small grains. Watermelons, muskmelons, pumpkins, and apples are grown less extensively. Most employment is in agriculture or related businesses. Industrial plants that manufacture nonagricultural products are in Norfolk.

Under dryland farming, about 8.6 percent of the total area is class I soils according to the land capability classification system used for this survey. Class II soils make up about 34.1 percent of the area; class III, 42.1 percent; class IV, 9.4 percent; class V, 1.0 percent; class VI, 4.2 percent; class VII, 0.1 percent; and class VIII, 0.2 percent. About 0.3 percent of the county's total area is water.

The first soil survey of Madison County was published in 1923 (*6*). This survey updates the earlier survey, provides additional information, and has larger maps that show the soils in greater detail.

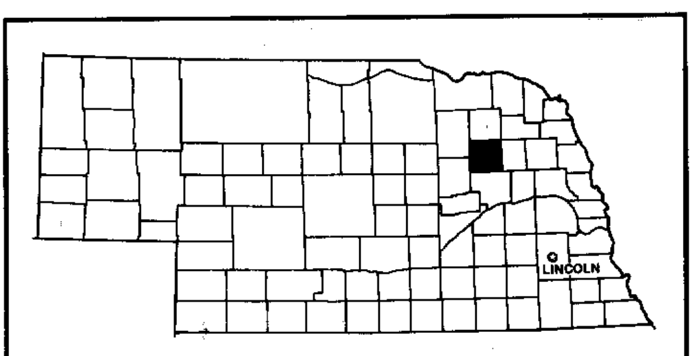

Figure 1.—Location of Madison County in Nebraska.

General Nature of the Survey Area

This section provides general information about Madison County. It discusses history and population; climate; physiography, relief, and drainage; geology and ground water; and trends in farming and soil use.

History and Population

The first settlement in Madison County was established in 1866. Located at the junction of the Elkhorn River and its north fork, it was eventually named Norfolk. The people who founded this settlement were Germans who had moved from Wisconsin and who named their county in remembrance of their old state capital. Madison County was organized late in 1867, and Norfolk was made the county seat. In 1876 the county seat was moved to Madison because of a pledge of land and a building for the county courthouse. It has remained there ever since. The Union Pacific Railroad entered Madison County in 1879.

According to the U.S. Bureau of the Census, 31,382 people lived in Madison County in 1980. Of these, 19,449 lived in Norfolk. Battle Creek had a population of 948; Madison had a population of 1,950; Meadow Grove had a population of 400; Newman Grove had a

population of 930; and Tilden, part of which is in Antelope County, had a population of 1,012.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Madison County is cold in winter and quite hot with occasional cool spells in summer. Precipitation during the winter frequently occurs as snowstorms. During the warm months, it is chiefly showers, often heavy, which occur when warm, moist air moves in from the south. Total annual rainfall is normally adequate for corn, soybeans, and small grains.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Madison, Nebraska, in the period 1951 to 1978. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 24° F, and the average daily minimum temperature is 12° F. The lowest temperature on record, which occurred at Madison, Nebraska February 28, 1962, is 32° F. In summer the average temperature is 74°, and the average daily maximum temperature is 87°. The highest recorded temperature, which occurred on July 11, 1954, is 110° F.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50° F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 25.29 inches. Of this, 20 inches, or 80 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 16 inches. The heaviest 1-day rainfall during the period of record was 5.79 inches at Madison on June 20, 1960. Thunderstorms occur on about 50 days each year, and most occur in summer.

Tornadoes and severe thunderstorms strike occasionally. These storms are local and of short duration and result in sparse damage in narrow belts. Hailstorms occur at times during the warmer part of the year in irregular patterns and in relatively small areas.

The average seasonal snowfall is 28 inches. The greatest snow depth at any one time during the period of record was 25 inches. An average of 28 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 60 percent in winter. The prevailing wind is from the northwest. Average windspeed is highest, 14 miles per hour, in spring.

Geology and Ground-Water Resources

The uppermost bedrock units underlying Madison County are the Cretaceous age Niobrara chalk and the Tertiary age Ogallala Formation. The Niobrara chalk underlies parts of the northeastern, south-central, and southeastern areas of the county. The Ogallala Formation overlies the Niobrara chalk throughout the rest of the county. This formation consists of poorly consolidated silt and sand that contains some gravel and clay. Its maximum thickness in Madison County is about 200 feet. The bedrock units are not exposed but are overlain by unconsolidated Quaternary sediments of sand, gravel, silt, and clay. These sediments range in thickness from slightly less than 50 feet in the Elkhorn River Valley to as much as 400 feet in the upland areas. Precambrian igneous rocks are found at depths ranging from about 2,400 feet below the land surface in the Elkhorn Valley to about 3,300 feet in the uplands in the southwestern part of the county.

The unconsolidated Quaternary sediments consist of wind-deposited silt (loess); ice-deposited silty clay that has rock fragments ranging in size from pebbles to boulders (glacial till); and water-deposited silt, sand, and gravel. The glacial till is present only in the eastern part of the county and generally is less than 150 feet thick. The sand and gravel deposit, which appears to be distributed throughout the entire county, varies in thickness and ranges from less than 20 feet to as much as 200 feet. Loess mantles the uplands in most of the southern half of the county, but has been removed by erosion from the Elkhorn Valley and from much of the northern half of the county.

The availability of ground water for domestic, livestock, and irrigation purposes varies within the county, depending on the occurrence and thickness of saturated materials that yield water at the desired rates. Coarse grained materials, such as sand and gravel, yield water at much greater rates than fine grained materials, such as silt and clay. For all practical purposes, even low-yielding domestic wells cannot be completed in clay, and only occasionally are large-diameter domestic wells completed in the silt.

The primary sources of ground water in Madison County are the sands and gravels that overlie the bedrock throughout most of the county and the Tertiary age Ogallala sediments. In the Elkhorn Valley, well depths commonly range between 50 and 150 feet. Depths to water generally range from between 10 and 20 feet near the Elkhorn River to as much as 50 feet along the valley sides. In the uplands, as much as 200 feet of loess and till may overlie the sand and gravel. Thus, well depths in the uplands generally range from 175 to 350 feet, and water levels generally range from 75 to 175 feet. In most of the upland area, one or more test holes need to be drilled to determine the amount of sand and gravel present. Water quality in the sand and

gravel generally is suitable for domestic, livestock, and irrigation uses. However, in parts of the uplands where large thicknesses of loess and till overlie the sand and gravel, the water may be quite hard and may have high concentrations of sulfates.

Some of the bedrock units underlying Madison County may yield significant amounts of water. Wells completed in the Niobrara chalk in the Elkhorn Valley obtain water from fractures, crevices, and solution cavities within the chalk. However, because adequate amounts of water generally can be obtained from the Quaternary sands and gravels in this area, the Niobrara chalk is not extensively used. Adequate amounts of water may also be obtained from Dakota sandstone that underlies the county. Depths to the top of the Dakota sandstone probably range between about 600 feet in the northeastern part of the county to about 1,100 feet in the southwestern part. Domestic wells may need to penetrate only the upper 20 to 50 feet of the sandstone, whereas irrigation wells may need to penetrate one to two hundred feet or more of the sandstone. Water quality in the Dakota sandstone generally is poorer than that in the sand and gravel.

Water yielding sandstones also are at depths of about 2,100 to 3,000 feet. However, the greater depths and generally poor water quality limit the economic feasibility of constructing wells in these units.

Physiography, Relief, and Drainage

Madison County is part of the Great Plains. The physiography of Madison County consists of bottom lands and stream terraces, loessial uplands, mixed sandy and loamy uplands, and a small area of sandhills. The bottom lands range from 1/2 mile to 4 miles in width and are mainly along the Elkhorn River and its major tributaries. The stream terraces are adjacent to the bottom lands and also are along the major creeks. Of major extent in Madison County are the loess uplands, which are extensive in all parts of the county. The mixed sandy and loamy uplands are transitional soil areas that are mainly south of the Elkhorn River but are also in the northern part of the county. These upland areas have a mixture of both the silty soils of the loess uplands and the sandy soils of the sandhills. The sandhills occur mainly in areas north of the Elkhorn River. These areas consist mainly of excessively drained sandy soils. In addition to these general soil areas, a small area of soils formed from glacial till is in the extreme northeast corner of the county.

About 33 percent of the soils in Madison County are nearly level, about 5 percent are very gently sloping, about 29.5 percent are gently sloping, about 27.3 percent are strongly sloping, about 4 percent are moderately steep, and about 0.9 percent are steep and very steep.

The most prominent relief in the county is the bluffs that border the Elkhorn River Valley on the north side, northwest of Battle Creek. Another bluff area is on the south side of Battle Creek Valley. In these areas, slopes range from steep to very steep. Maximum relief between the ridgetops and bottom of the adjacent drainageways is about 120 to 160 feet. The lowest point in the county, about 1,500 feet above sea level, is southeast of Norfolk; and the highest point, about 1,900 feet above sea level, is in the southwestern part.

In the loess hills the slopes range from nearly level on the tablelands to very steep on side slopes to drainageways. Most of the slopes are gently sloping to moderately steep. In the sandy areas relief ranges from nearly level to hummocky, depending on the amount of wind action to which the sandy material has been exposed. The stream terraces and bottom lands are nearly level to gently sloping.

Madison County is drained by the Elkhorn River and by tributaries of the Platte River. Except for some small, sandy areas on both sides of the Elkhorn River, all areas of the uplands are reached by drainageways. The Elkhorn River flows from the west to the southeast and, with its tributaries, drains nearly 94 percent of the county. In the northern part of the county, Spring Fork and North Fork of the Elkhorn River flow south through Norfolk and into the Elkhorn River southeast of Norfolk. In the western part of the county, Buffalo Creek, Dry Creek, and Sand Creek flow north toward the Elkhorn River. Battle Creek, in the west-central part of the county, flows east for about 11 miles and then turns north toward the Elkhorn River. Union Creek flows from the east to the northeast through the southern part of Madison County. It eventually flows into the Elkhorn River in adjacent Stanton County. Taylor Creek flows southeast toward Union Creek and joins Union Creek in the town of Madison. Sand Creek, in the east-central part of the county, flows east; and the extreme southwest part of Madison County is drained by Shell Creek, which flows southeast into the Platte River.

Soils in Madison County are mainly silty, loamy, or sandy. Only a few soils have clayey textures. The soils are deep and range from excessively drained to very poorly drained. About 1 percent of the soils are excessively drained, about 11.9 percent are somewhat excessively drained, about 73.9 percent are well drained, 0.8 percent are moderately well drained, about 10.4 percent are somewhat poorly drained, about 1.6 percent are poorly drained, and about 0.4 percent are very poorly drained.

Transportation

State highways and county roads provide most of the transportation in Madison County. U.S. Highway 275 passes through the northern part of the county. U.S. Highway 81 passes through the eastern part. Nebraska

Highway 32 passes through the southern part of the county, and Nebraska Highway 24 runs diagonally along the Elkhorn River southeast of Norfolk. Nebraska Highway 45 passes through the western edge of the county between Newman Grove and Tilden. Roads are on most section lines. A few are hard surfaced, but most are graveled, and a few, along seldom used routes, are dirt. The Chicago and Northwestern Railroad traverses the county in the Elkhorn River Valley. The Union Pacific Railroad traverses the eastern part of Madison County through Madison and Norfolk.

Trends in Farming and Soil Use

Farming has been the most important enterprise in Madison County since the county was settled. In the early years crops were grown only for local use. When railroads and grain elevators made markets available, crop and livestock production increased. As a result of a rapid expansion in the use of irrigation, more efficient machinery, herbicides and pesticides, and higher crop yields, farm income has increased significantly.

The Nebraska Agricultural Statistics for 1970 listed 1,220 farms in Madison County (*3*). By 1979 the number of farms had decreased to 1,100 (*5*). This reduction was due mostly to an increase in the size of farms but also to the effects of urban expansion, mainly in the northeast part of the county. Most of these farms are combination cash-grain and livestock operations.

The acreage in irrigated crops is steadily increasing. In 1970, 17,700 acres was irrigated; and by 1979 this figure had increased to 66,000 acres (*3, 5*). Most of the irrigation water comes from wells, but some is pumped from the Elkhorn River and other major streams. The largest increase in irrigated acreage in the last five years has resulted from the use of center-pivot systems. In 1971 Madison County had 141 irrigation wells, and by 1980 it had 535. More wells are being drilled each year.

Corn is the main cultivated crop in Madison County. Other crops grown are soybeans, alfalfa, sorghum, oats, introduced grasses, wheat, and rye. The acreage in corn and soybeans has generally increased over the last ten years. According to the Nebraska Agricultural Statistics, 115,000 acres of corn was grown in 1970; of this, 10,500 acres was irrigated. By 1978, the acreage planted to corn increased to 146,900 acres, of which 56,400 acres was irrigated. Soybeans were planted on 34,400 acres in 1970, and by 1977 the acreage in soybeans had increased to 56,000 acres. The acreage of alfalfa, oats, and sorghum has remained about the same for the last ten years. In 1978 there were 25,200 acres of alfalfa, 13,500 acres of oats, and 2,300 acres of grain sorghum in Madison County.

Livestock is important on most farms in Madison County; however, the number of cattle and most other livestock has decreased in recent years. In 1970 there were 72,500 cattle, but by 1979 this number decreased to 71,600. The number of dairy cattle decreased from 4,700 in 1970 to 3,000 in 1979. The number of hogs decreased from 85,000 in 1970 to 65,000 in 1979. Many farms fatten a few hogs for market, and in a few places hogs are fed in confinement areas. The number of chickens raised in the county decreased between 1970 and 1979, but the number of sheep increased. In 1979 there were 2,300 sheep and 69,100 chickens.

Watermelons, muskmelons, pumpkins, and apples are grown on some farms for commercial use.

The amount of fertilizer used in Madison County has increased greatly since 1970. In 1970, farmers in the county used 17,628 tons of commercial fertilizer; by 1979, 36,000 tons was used.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and

other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas called soil associations that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, a soil association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one soil association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Association Descriptions

Silty soils on uplands

Two associations are in this group. The soils are deep, nearly level to steep, and well drained and somewhat excessively drained. Most of the acreage of this group is cultivated, generally under dryland farming. The soils that have steep slopes are mainly in rangeland or pasture. Where wells are available, some of the acreage is irrigated, commmonly by the center-pivot system. Water erosion is the principal hazard on these soils. Maintaining a high level of fertility and conserving water and soil are the main concerns of management.

1. Nora-Crofton-Moody Association

Deep, nearly level to steep, well drained and somewhat excessively drained silty soils that formed in loess; on uplands

This association consists mainly of gently sloping to strongly sloping soils on divides and of moderately steep and steep soils on hillsides (fig. 2). Slopes range from 0 to 30 percent.

This association occupies about 187,880 acres, or about 51 percent of the county. It consists of about 36 percent Nora soils, 20 percent Crofton soils, 16 percent Moody soils, and 28 percent soils of minor extent.

Nora soils are on gently sloping to strongly sloping ridgetops and on strongly sloping to moderately steep lower side slopes of the loess uplands. These soils are deep and well drained. Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is friable silty clay loam about 22 inches thick. It is brown in the upper part and pale brown and calcareous in the lower part. The underlying material is calcareous silt loam to a depth of more than 60 inches. It is pale yellow in the upper part and very pale brown in the lower part.

Crofton soils are on gently sloping, narrow ridgetops and the upper side slopes of strongly sloping to steep hillsides on loess uplands. These soils are deep, well drained, and somewhat excessively drained. Typically, the surface layer is grayish brown, very friable silt loam about 5 inches thick. Beneath this is a layer of pale brown, very friable, calcareous silt loam about 5 inches thick. The underlying material is calcareous silt loam. It is pale brown in the upper part and light yellowish brown in the lower part to a depth of more than 60 inches.

Moody soils are on nearly level to gently sloping ridgetops and side slopes of loess uplands. These soils are deep and well drained. Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is firm, silty clay loam about 32 inches thick. It is dark grayish brown in the upper part, brown in the middle part, and yellowish brown and light yellowish brown in the lower part. The underlying material is pale brown and light yellowish brown silt loam to a depth of more than 60 inches.

Minor soils in this association are mainly in the Alcester, Belfore, Hobbs, and Shell series. Alcester soils have a thick, dark surface soil and are on gently sloping foot slopes below Nora and Crofton soils. Belfore soils are on broad, nearly level divides on loess uplands slightly higher on the landscape than the Nora, Crofton, and Moody soils. Belfore soils have more clay in the subsoil. Hobbs and Shell soils are in narrow upland drainageways and are flooded occasionally.

Farms in this association are diversified, mainly combining cash-grain and livestock operations. Most of the acreage is in dryland cultivated crops. Corn, soybeans, grain sorghum, oats, and alfalfa are the main crops. A few areas are in introduced grasses or native grasses and are grazed by cattle or mowed for hay. Some areas are irrigated by sprinklers, commonly the self-propelled, center-pivot system. The irrigation wells commonly produce high yields. Many farms fatten beef

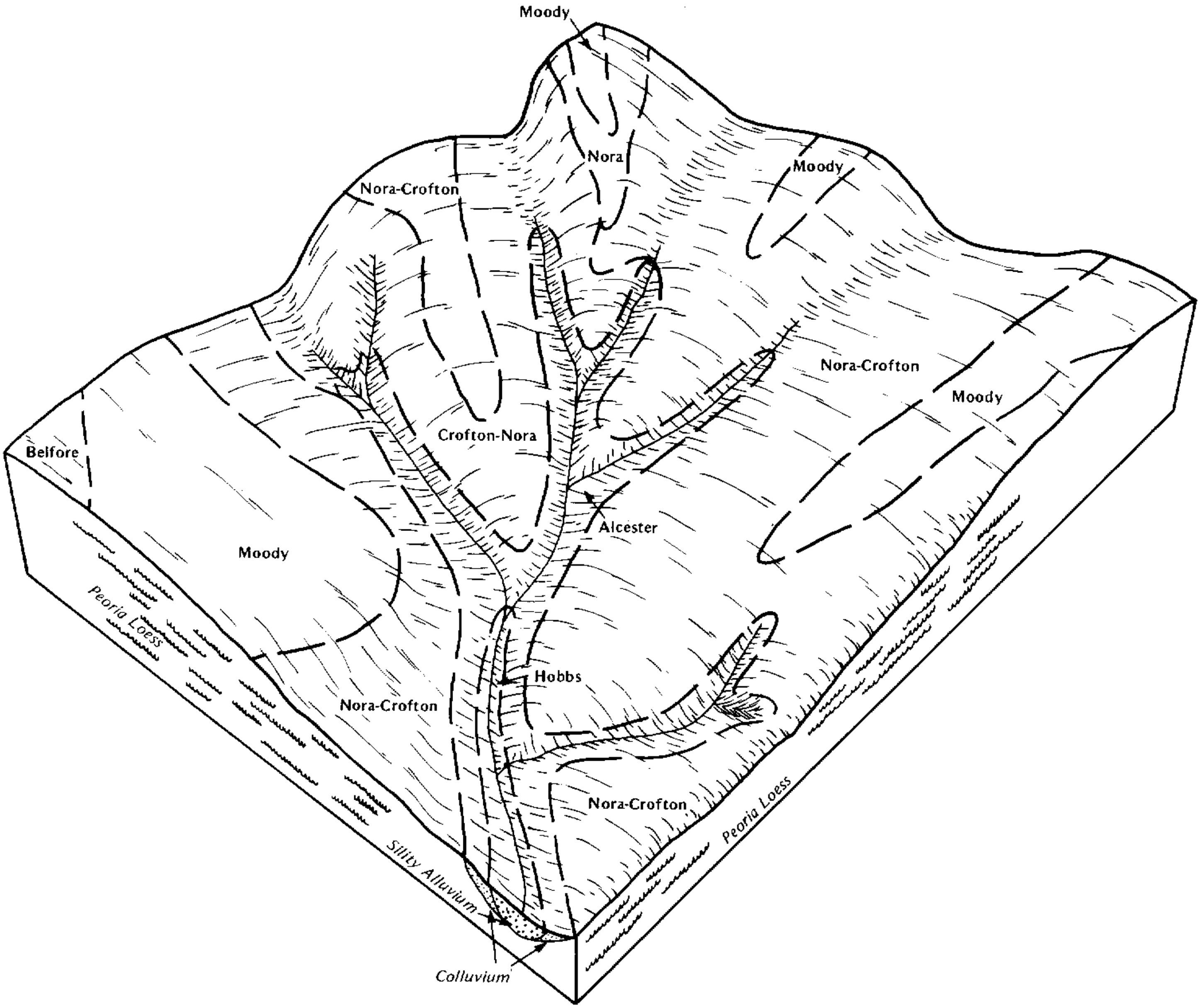

Figure 2.—Typical pattern of soils and their parent material in the Nora-Crofton-Moody association.

cattle and hogs, and some farms have a small dairy herd. Cattle winter on the forage crops.

Water erosion, rapid runoff, and maintenance of soil fertility are important concerns in cultivated areas. Distributing an adequate amount of irrigation water and, at the same time, adequately controlling erosion are the main concerns in managing irrigated areas. Range management that includes proper grazing use, timely deferment of grazing, and a planned grazing system helps maintain or improve the range condition.

2. Belfore-Moody-Nora Association

Deep, nearly level to strongly sloping, well drained silty soils that formed in loess; on uplands

In this association the landscape consists mainly of long, smooth, nearly level to strongly sloping divides on uplands (fig. 3). Slopes range from 0 to 11 percent.

This association occupies about 16,500 acres, or about 5 percent of the county. It consists of about 52 percent Belfore soils, 30 percent Moody soils, 10

percent Nora soils, and 8 percent minor soils.

Belfore soils are on long, smooth divides of loess uplands. They are deep, nearly level, and well drained. Typically, the surface soil is dark grayish brown, friable silty clay loam about 13 inches thick. The subsoil, about 35 inches thick, is brown, firm silty clay in the upper and middle parts and yellowish brown, firm silty clay loam in the lower part. The underlying material is light yellowish brown silt loam and extends to a depth of more than 60 inches.

Moody soils are on gently sloping ridgetops and side slopes of loess uplands. These soils are deep and well drained. Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is firm silty clay loam about 32 inches thick. It is dark grayish brown in the upper part, brown in the middle part, and yellowish brown and light yellowish brown in the lower part. The underlying material is pale brown and light yellowish brown silt loam to a depth of more than 60 inches.

Nora soils are on long, smooth side slopes below the Belfore and Moody soils. These soils are on gently sloping to strongly sloping ridgetops and on strongly sloping side slopes of the loess uplands. They are deep and well drained. Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is brown and pale brown, friable silty clay loam about 22 inches thick. The underlying material is calcareous silt loam. It is pale yellow in the upper part and very pale brown in the lower part to a depth of more than 60 inches.

Minor soils in this association are mainly of the Alcester, Crofton, Fillmore, and Hobbs series. Alcester soils are on foot slopes below the Nora soils. Alcester soils have a dark surface layer more than 20 inches thick. Crofton soils are gently sloping on narrow ridgetops and strongly sloping on hillsides. Crofton soils have a light colored, calcareous surface layer. Fillmore soils are in upland depressions and are sometimes ponded. Nearly level Hobbs soils are on occasionally flooded, narrow upland drains.

Farms in this association are diversified, mainly combining cash-grain and livestock operations. Most of the acreage is in cropland, and much of the cultivated acreage is irrigated by gravity and sprinkler systems. A few areas, commonly small plots close to the farmstead,

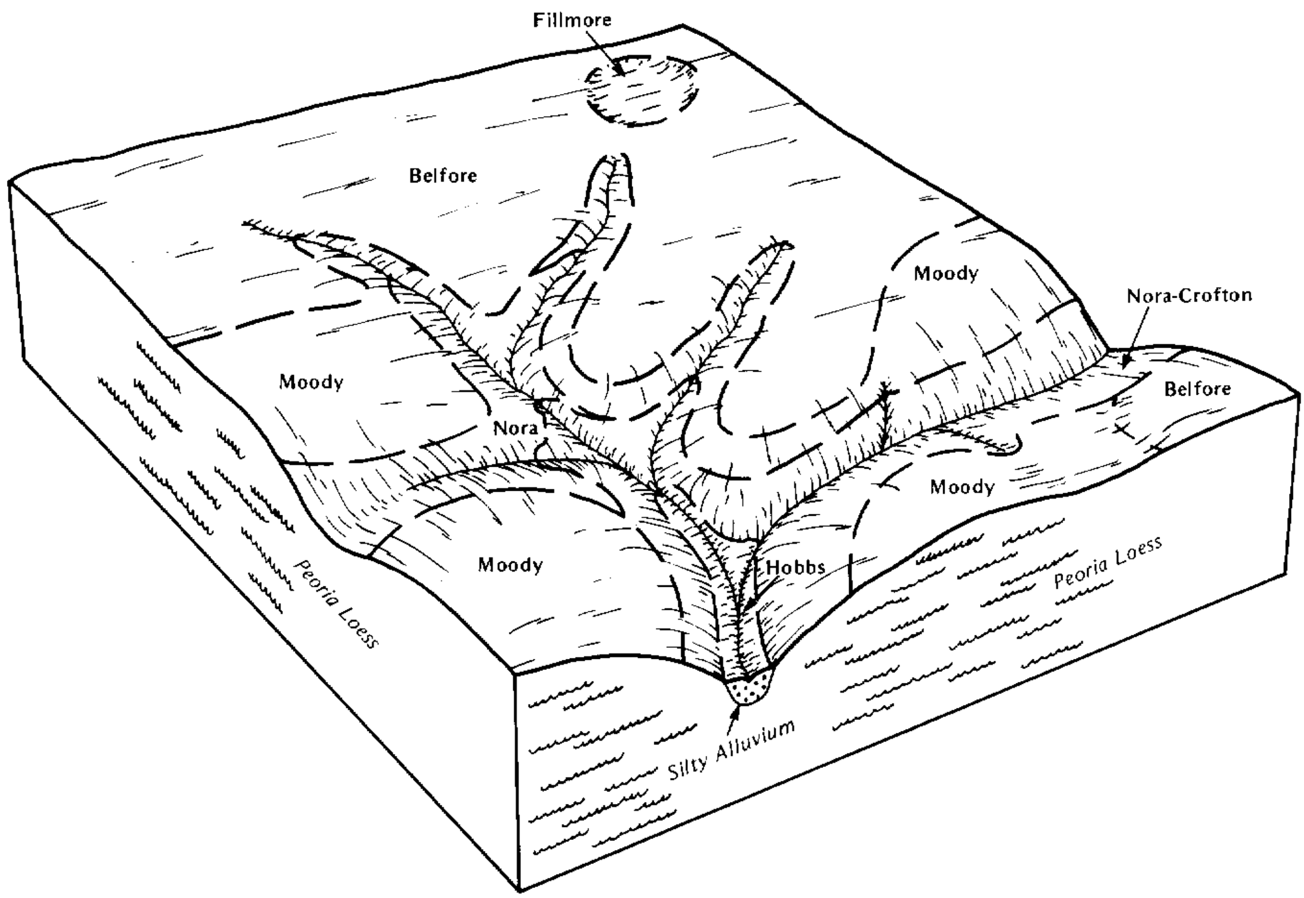

Figure 3.—Typical pattern of soils and their parent material in the Belfore-Moody-Nora association.

are in range or pasture that is used for grazing. Corn, soybeans, grain sorghum, oats, and alfalfa are the main crops. Cattle winter on forage crops.

Water erosion on the gently sloping and strongly sloping soil areas is the main hazard. Maintaining fertility and tilth are management concerns on the nearly level soil areas. Using adequate amounts of irrigation water and at the same time controlling erosion on the sloping areas are concerns in managing irrigated areas. Many of the nearly level areas are well suited to gravity irrigation.

Sandy and loamy soils on uplands and stream terraces

Two associations are in this group. The soils are deep, nearly level to strongly sloping, and somewhat excessively drained and well drained. Most of the acreage of this group is cultivated and farmed dryland. Some of the sandy soils are in introduced or native grass. A small part of the acreage is irrigated, generally by a center-pivot or other sprinkler system. Soil blowing and water erosion are the main hazards. Conserving water for plant use and maintaining fertility are the main concerns of management.

3. Thurman-Loretto-Boelus Association

Deep, nearly level to strongly sloping, somewhat excessively drained and well drained sandy and loamy soils that formed in eolian sands and loess; on uplands and stream terraces

In this association the landscape consists mainly of nearly level to strongly sloping, wide and smooth areas on uplands and stream terraces (fig. 4). Slopes range from 0 to 11 percent.

This association occupies about 70,500 acres, or about 19 percent of the county. It consists of about 42 percent Thurman soils, 15 percent Loretto soils, 10 percent Boelus soils, and 33 percent soils of minor extent.

Thurman soils are on very gently sloping to strongly sloping areas of eolian sand uplands and nearly level areas on stream terraces. These soils are deep and somewhat excessively drained. Typically, the surface soil is dark grayish brown, very friable loamy fine sand about 12 inches thick. The next layer is grayish brown, very friable loamy fine sand about 5 inches thick. The underlying material is fine sand. The upper part is light

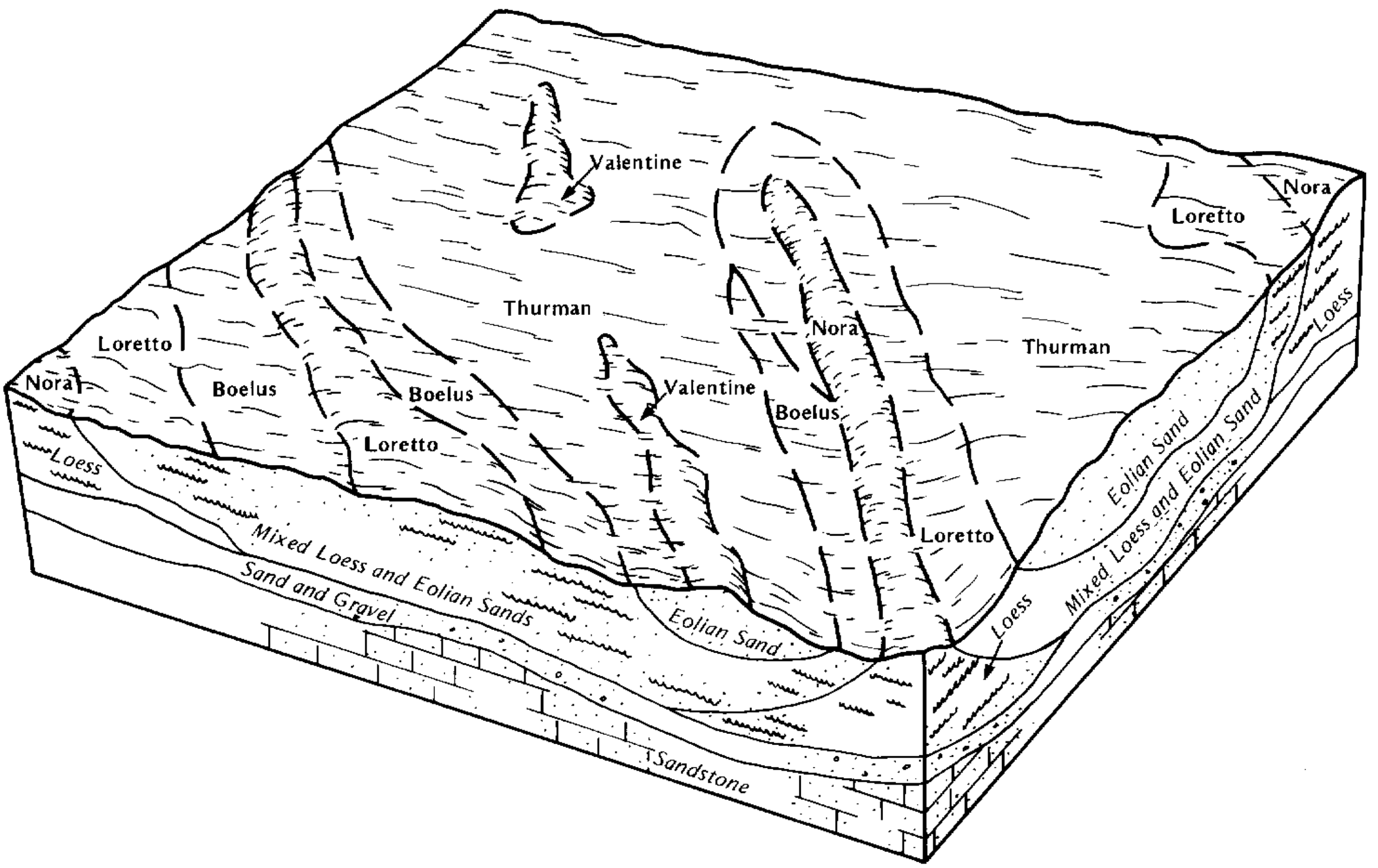

Figure 4.—Typical pattern of soils and their parent material in the Thurman-Loretto-Boelus association.

yellowish brown, and the lower part is very pale brown to a depth of more than 60 inches.

Loretto soils formed in mixed eolian sand and silt on uplands and on stream terraces. These soils are deep, nearly level to gently sloping, and well drained. Typically, the surface soil is very friable fine sandy loam about 16 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The subsoil is friable and about 36 inches thick. It is brown loam in the upper part and pale brown silt loam in the lower part. The underlying material is brown silt loam to a depth of more than 60 inches.

Boelus soils formed in eolian sands over loess on uplands. These soils are deep, very gently sloping or gently sloping, and well drained. Typically, the surface soil is very friable loamy fine sand about 14 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The next layer is grayish brown, very friable loamy fine sand about 10 inches thick. The subsoil is friable silty clay loam about 26 inches thick. It is pale brown in the upper part and light yellowish brown in the lower part. The underlying material is very pale brown silt loam to a depth of more than 60 inches.

Minor soils in this association are mainly in the Blendon, Elsmere, Nora, and Valentine series. The well drained Blendon soils are in concave areas on stream terraces slightly lower on the landscape than the Thurman, Loretto, and Boelus soils. Blendon soils have a dark surface layer more than 20 inches thick. The somewhat poorly drained Elsmere soils and the well drained Nora soils are lower on the landscape. The sandy Valentine soils are on the highest parts of the landscape.

Farms in this association are diversified, mainly combining cash-grain and livestock operations. Corn, soybeans, oats, and alfalfa are the main crops. Most of the acreage is in dryland crops. A part of the area is irrigated by sprinklers, commonly by the center-pivot system. Yields of irrigation water by wells are high. Many farms have small pastures in smooth brome or native grasses. Cattle winter on the forage crops.

Soil blowing, the main hazard in cultivated areas, can be controlled by conservation tillage practices that keep crop residue on the surface. Water erosion is a hazard in areas that have long, smooth slopes. Maintaining soil fertility, improving organic matter content, and using irrigation water efficiently are the important concerns of management in cultivated areas. Range management that includes proper grazing use, timely deferment of grazing, and a planned grazing system helps to maintain or improve the range condition.

4. Thurman-Hadar-Blendon Association

Deep, nearly level to strongly sloping, somewhat excessively drained and well drained sandy and loamy soils that formed in eolian sands, alluvium, and glacial till; on uplands and stream terraces

In this association the landscape consists mainly of gently undulating convex ridges and gently sloping to strongly sloping upland side slopes. It also consists of nearly level areas on stream terraces. Slopes range from 0 to 11 percent.

This association occupies about 3,500 acres, or about 1 percent of the county. It consists of about 31 percent Thurman soils, 24 percent Hadar soils, and 20 percent Blendon soils. The remaining 25 percent is minor soils.

Thurman soils are on low ridges and long, undulating areas on sandy eolian uplands and stream terraces. They are very gently sloping to strongly sloping, deep, and somewhat excessively drained soils. Typically, the surface soil is dark grayish brown, very friable loamy fine sand about 12 inches thick. The next layer is grayish brown, very friable loamy fine sand about 5 inches thick. The underlying material is fine sand to a depth of more than 60 inches. The upper part is light yellowish brown, and the lower part is very pale brown.

Hadar soils are deep, gently undulating to gently rolling, well drained soils that formed in eolian sands over glacial till on uplands. Typically, the surface soil is dark grayish brown, very friable loamy fine sand about 14 inches thick. The upper part of the subsoil is brown, very friable loamy fine sand about 10 inches thick. The lower part is light yellowish brown firm, mottled clay loam about 12 inches thick. The underlying material is clay loam to a depth of more than 60 inches. It is light gray and mottled in the upper part, and it is gray and mottled in the lower part.

The Blendon soils are deep, nearly level, well drained soils on stream terraces. These soils formed in mixed eolian sands and alluvium. Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 10 inches thick. The subsoil is about 28 inches thick. The upper part is very dark gray, very friable fine sandy loam. The lower part is dark grayish brown, friable fine sandy loam. The underlying material is pale brown loamy fine sand to a depth of more than 60 inches.

Minor soils in this association are mainly in the Clarno, Crofton, Elsmere, Lawet, and Loup series. Clarno soils formed in till on ridgetops and side slopes and are on the same landscape as the Thurman, Hadar, and Blendon soils. Crofton soils formed in loess on ridgetops and side slopes and are strongly sloping. Elsmere soils are somewhat poorly drained and are in basins and depressions. Lawet and Loup soils are poorly drained and are on bottom lands lower on the landscape.

Farms in this association are diversified, mainly combining cash-grain and livestock operations. Most of the acreage is used for dryland crops and pasture. A few acres are irrigated, and a few areas are in range that is used for grazing or hay. Corn, soybeans, oats, and alfalfa are the main crops. Smooth brome is the main grass in areas used for pasture. The potential for additional irrigation is low because high-yielding wells are

not common. Cattle winter on the forage crops. Two housing developments are in this association.

Soil blowing is the main hazard in cultivated areas. Water erosion is a hazard on long, smooth slopes. Improving the organic matter content and maintaining soil fertility are concerns of management. In irrigated areas, the main concerns are using the proper amount of water, properly timing its distribution, and adequately controlling erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help to improve or maintain the range condition.

Sandy soils on uplands

These soils are deep, very gently sloping to steep, and somewhat excessively drained and excessively drained. About one-half of the acreage of this group is in rangeland and is used for grazing or hay. About one-half of the acreage is cultivated and sprinkler irrigated. Soil blowing is a hazard in areas where the soils are overgrazed. Keeping the range in good condition is an important concern of management.

5. Thurman-Valentine Association

Deep, very gently sloping to steep, somewhat excessively drained and excessively drained sandy soils that formed in eolian sands; on uplands

In this association the landscape consists mainly of very gently sloping to steep, smooth, rounded sandhills. There are few established drainage channels. Slopes range from 1 to 20 percent.

This association occupies about 3,500 acres, or about 1 percent of the county. It consists of about 50 percent Thurman soils, 30 percent Valentine soils, and 20 percent minor soils.

The very gently sloping to strongly sloping Thurman soils are on low ridges and side slopes. These soils are deep and somewhat excessively drained. Typically, the surface soil is dark grayish brown, very friable loamy fine sand about 12 inches thick. The next layer is grayish brown, very friable loamy fine sand about 5 inches thick. The underlying material is fine sand. The upper part is light yellowish brown, and the lower part is very pale brown to a depth of more than 60 inches.

The gently sloping to steep Valentine soils are on hummocks and side slopes. They are deep and excessively drained. Typically, the surface layer is dark grayish brown, loose fine sand about 6 inches thick. The next layer is brown, loose fine sand about 4 inches thick. The underlying material is pale brown and very pale brown fine sand to a depth of 60 inches.

Minor soils of this association are in the Blendon, Boelus, Elsmere, and Loretto series. Blendon soils have less sand in the upper 40 inches and are lower on the landscape than the Thurman and Valentine soils. Boelus soils are well drained, have a silt loam subsoil, and are on long, smooth areas lower on the landscape. Elsmere soils are somewhat poorly drained and are lower on the landscape. Loretto soils are well drained and are below Thurman and Valentine soils on the landscape.

Farms in this association are diversified, mainly combining cash-grain and livestock operations. About one-half of the acreage is used for cultivated crops, and most of the cultivated areas are irrigated by center-pivot systems. The rest of the acreage is in rangeland and is used for grazing or mowed for hay. The main crops grown under irrigation are corn, soybeans, and alfalfa. Soil blowing is the main hazard in cultivated areas. Distributing irrigation water in the proper amounts and at the proper times and adequately controlling soil blowing are the main concerns in irrigated areas. Maintaining soil fertility and improving organic matter content are management concerns in cultivated areas of these soils. Range management that includes proper grazing use, timely deferment of grazing, and a planned grazing system helps to maintain or improve the range condition.

Silty soils on bottom lands and stream terraces

The soils in this group are deep, nearly level, and well drained. Most of the acreage is in cultivated crops, and most of this is irrigated by gravity systems. A few sprinkler systems are also used. A small part of this association is farmed dryland. Some small areas along the deeply entrenched stream channels are in rangeland or pasture. Flooding is rare on the higher part of the bottom lands and occasional or frequent on the lower part. Maintenance of soil fertility and efficient use of irrigation water are important concerns of management.

6. Muir-Shell-Hobbs Association

Deep, nearly level, well drained silty soils that formed in alluvium; on bottom lands and stream terraces

In this association the landscape consists mainly of long, nearly level areas on bottom lands and stream terraces. Slopes range from 0 to 2 percent.

This association occupies about 35,000 acres, or about 10 percent of the county. It consists of about 30 percent Muir soils, 24 percent Shell soils, 20 percent Hobbs soils, and 26 percent soils of minor extent.

Muir soils formed in silty alluvium on stream terraces. They are deep, nearly level, and well drained. Typically, the surface soil is dark grayish brown, friable silty clay loam about 18 inches thick. The subsoil is friable silty clay loam about 28 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material is brown silt loam to a depth of more than 60 inches.

Shell soils formed in silty alluvium on long areas of bottom lands. These soils are deep, nearly level, and well drained. They are subject to occasional flooding. Typically, the surface soil is friable silty clay loam 26 inches thick. It is dark grayish brown in the upper part and very dark grayish brown in the lower part. The underlying material is stratified brown and dark grayish

brown silty clay loam to a depth of 46 inches. Beneath this material is a buried soil. It is very dark grayish brown silty clay loam to a depth of more than 60 inches.

Hobbs soils formed in stratified alluvium in long, narrow areas of bottom lands and narrow drainageways. These soils are deep, nearly level, well drained and are subject to occasional flooding. Typically, the surface layer is grayish brown, very friable silt loam about 8 inches thick. The underlying material is stratified grayish brown and light brownish gray silt loam in the upper part and brown and pale brown in the lower part. Below this material is a buried soil of dark grayish brown silt loam that extends to a depth of more than 60 inches. Some areas of Hobbs soils are frequently flooded and are channeled.

Minor soils in this association are mainly in the Colo, Gibbon, Lamo, Moody, and Zook series. The somewhat poorly drained Colo, Gibbon, and Lamo soils and the poorly drained Zook soils are all lower on the landscape than the major Muir, Hobbs, and Shell soils. The Moody soils are on terraces, slightly higher on the landscape.

Farms in this association are diversified, mainly combining cash-grain and livestock operations. Most of the acreage is in cultivated crops. Corn, soybeans, grain sorghum, and alfalfa are the main crops. A substantial part of this acreage is irrigated. Deep, high-yielding wells can be obtained, and some farmers near Union Creek pump water from the creek. Gravity irrigation is well suited to these soils, but some areas are irrigated by a sprinkler system. Some areas near stream channels are occasionally flooded, and others are frequently flooded; these areas are used for small pastures of introduced and native grasses. Cattle winter on the forage crops.

In areas of the Shell and Hobbs soils, flooding in the spring and early summer may damage young plants and bring in fresh deposits of silty sediments. Maintaining soil fertility and organic matter content are management concerns in cultivated areas of this association. Proper distribution of irrigation water is the main concern in irrigated areas. Range management that includes proper grazing use, timely deferment of grazing, and a planned grazing system helps to maintain or improve the range condition.

Sandy, loamy, and silty soils on bottom lands

Two associations are in this group. The soils are deep, nearly level to gently sloping, and are somewhat excessively drained, somewhat poorly drained, and poorly drained. Most of the acreage near the Elkhorn River is in mixed native grass and trees and is used for grazing and for wildlife habitat. The part most distant from the river is cultivated and farmed dryland. A small part is irrigated by gravity and sprinkler systems. Soil blowing, droughtiness, and flooding are the main hazards. In places, wetness due to the high water table is a limitation. Maintaining organic matter content and improving fertility are concerns of management. Where the areas are in range, maintaining the grasses in good condition is the principal concern.

7. Ord-Inavale-Boel Association

Deep, nearly level and gently sloping, somewhat poorly drained and somewhat excessively drained loamy and sandy soils that formed in alluvium; on bottom lands

In this association the landscape consists mainly of bottom lands of the Elkhorn River Valley. The soils are mainly nearly level and gently sloping. A few areas are dissected by shallow swales and old channels, and a few areas have gently undulating topography (fig. 5). Slopes ranges from 0 to 6 percent.

This association occupies about 15,200 acres, or about 4 percent of the county. It consists of about 26 percent Ord soils, 20 percent Inavale soils, 17 percent Boel soils, and 37 percent soils of minor extent.

Ord soils are deep, nearly level, somewhat poorly drained soils that formed in stratified sandy alluvium on bottom lands. Typically, the surface soil is friable and about 16 inches thick. It is very dark grayish brown loam in the upper part and dark grayish brown fine sandy loam in the lower part. Beneath this is a layer of grayish brown, very friable fine sandy loam about 8 inches thick. The underlying material to a depth of more than 60 inches is light brownish gray fine sandy loam in the upper part, light gray fine sand in the middle part, and light brownish gray mottled fine sand in the lower part.

The Inavale soils are deep, nearly level or gently sloping, somewhat excessively drained soils that formed in sandy alluvium on low ridges of the Elkhorn River bottom lands. Typically, the surface layer is dark gray, very friable loamy fine sand about 7 inches thick. Beneath this is a layer of grayish brown, very friable loamy fine sand about 8 inches thick. The underlying material to a depth of more than 60 inches is pale brown fine sand in the upper part, pale brown very fine sandy loam in the middle part, and very pale brown fine sand in the lower part.

Boel soils are deep, nearly level, somewhat poorly drained soils that formed in sandy alluvium on bottom lands of the Elkhorn River Valley. Typically, the surface soil is dark grayish brown and dark gray, fine, friable sandy loam about 11 inches thick. Beneath this is a layer of grayish brown, very friable fine sandy loam about 4 inches thick. The underlying material at 15 inches is mottled fine sand. It is light brownish gray in the upper part, and light gray in the lower part to a depth of more than 60 inches.

Of minor extent in this association are Cass, Lamo, Loup, and Marlake soils and Pits and dumps. Cass soils are well drained and higher in elevation than the Ord, Inavale, and Boel soils. The poorly drained and very poorly drained Marlake and Loup soils are in old oxbow stream channels lower in elevation than the major soils. Lamo soils have more clay in the upper 40 inches and

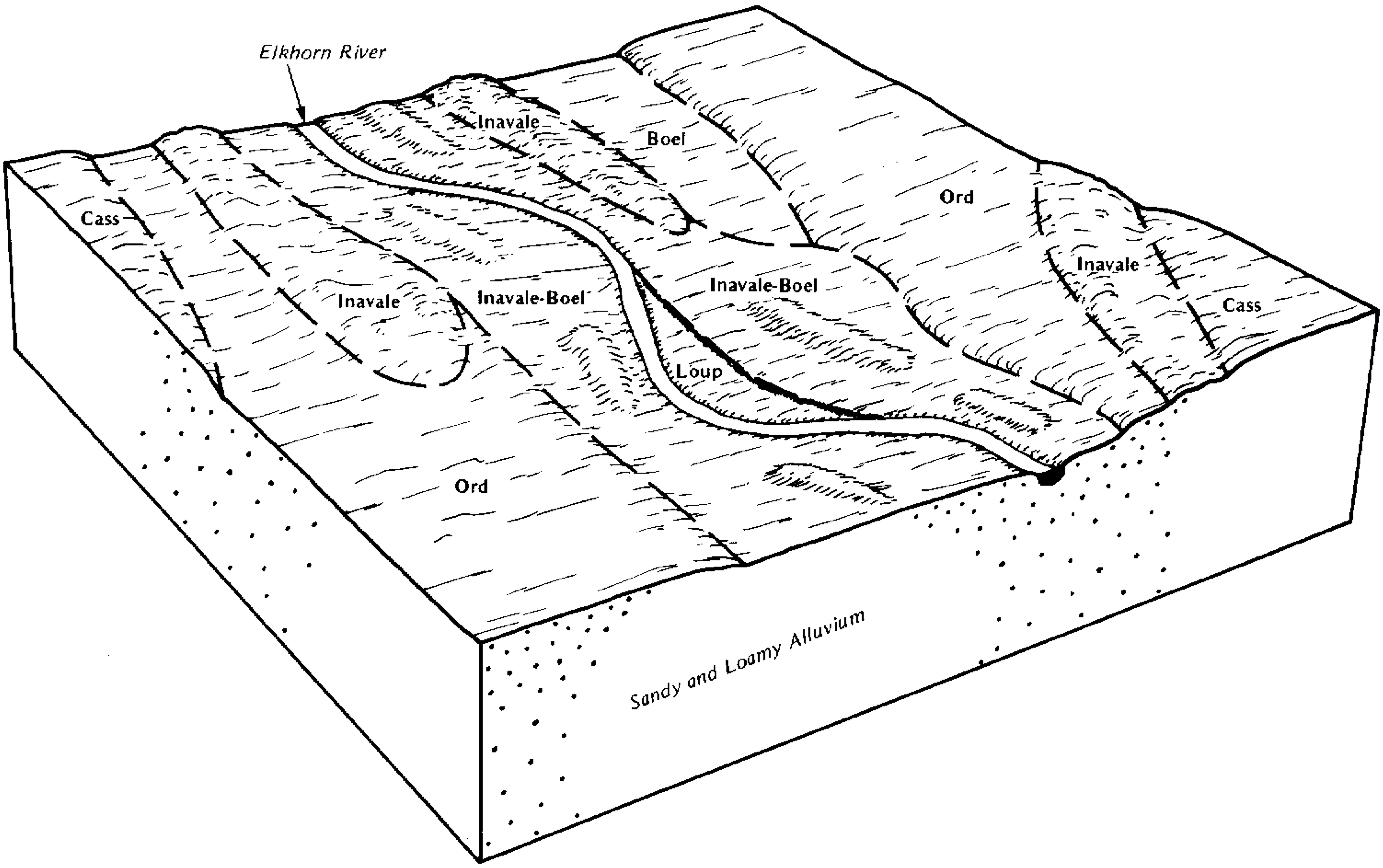

Figure 5.—Typical pattern of soils and their parent material in the Ord-Inavale-Boel association.

are on landscape positions similar to those of the Ord and Boel soils. Pits and dumps are near channels of the Elkhorn River.

Very few farmsteads are in this association. Most of the acreage is covered by mixed native grasses and trees or introduced grasses.

These areas are used mainly for grazing cattle, for recreation, and for wildlife habitat. Wildlife is fairly abundant in this association. A few small areas are used for cultivated crops, mainly corn and soybeans. These soils are poorly suited to irrigation because of flooding, wetness from the high water table, and the high risk of soil blowing.

Soil blowing, droughtiness, and flooding are hazards if these soils are used for cultivated crops. Conserving water, maintaining a plant cover, and improving fertility are management concerns. Proper grazing use and a planned grazing system are needed where these soils are used for rangeland.

8. Gibbon-Lamo-Ord Association

Deep, nearly level, somewhat poorly drained and poorly drained silty and loamy soils that formed in alluvium; on bottom lands

The landscape in this association consists mainly of wide, level and nearly level bottom lands in the Elkhorn River Valley and in the valleys of other major streams. Slopes range from 0 to 2 percent.

This association occupies about 23,500 acres, or about 6 percent of the county. It consists of about 40 percent Gibbon soils, 17 percent Lamo soils, 12 percent Ord soils, and 31 percent soils of minor extent.

Gibbon soils are deep, nearly level, somewhat poorly drained soils that formed in silty alluvium on bottom lands. Typically, the surface soil is very dark gray and gray, calcareous, very friable silty clay loam about 19 inches thick. The underlying material to a depth of more than 60 inches is light gray, calcareous silt loam in the upper part and gray fine sandy loam in the lower part.

Lamo soils are deep, nearly level, somewhat poorly drained and poorly drained soils that formed in silty alluvium on wide bottom lands of the Elkhorn River Valley. Typically, the surface soil is very dark gray and dark gray, friable silty clay loam about 20 inches thick. Beneath this is a layer of gray, firm silty clay loam about

12 inches thick. The underlying material to a depth of more than 60 inches is light brownish gray, calcareous silty clay loam in the upper part and gray, calcareous silty clay loam in the lower part.

Ord soils are deep, nearly level, somewhat poorly drained soils that formed in sandy alluvium on bottom lands of the Elkhorn River. Typically, the surface soil is about 16 inches thick. It is dark grayish brown, friable loam in the upper part and dark grayish brown, friable fine sandy loam in the lower part. Beneath this is a layer of grayish brown, very friable fine sandy loam about 8 inches thick. The underlying material to a depth of more than 60 inches is light brownish gray fine sandy loam in the upper part, light gray fine sand in the middle part, and light brownish gray, mottled fine sand in the lower part.

Minor soils in this association are in the Cass, Gayville, Shell, and Zook series. Cass soils are well drained and higher on the landscape than the Gibbon, Lamo, and Ord soils. Gayville soils have high alkalinity and are on the same landscape. Shell soils are well drained and higher on the landscape. Zook soils are lower on the landscape than the major soils.

Farms in this association are diversified, mainly combining cash-grain and livestock operations. Most of the acreage is in dryland crops and pasture. Corn, soybeans, grain sorghum, and alfalfa are the main crops. Some areas are irrigated. These soils are suited to both gravity and sprinkler systems. Some of the acreage is in native grasses and is used for grazing or mowed for hay. Cattle winter on the forage crops.

Wetness caused by the seasonal high water table and the flooding is the main limitation to use of these soils for cropland. Drainage is needed on the silty clay loam and silt loam soils to improve ease of tillage. Improving fertility and tilth are the main concerns of management.

Distributing adequate amounts of water and fertilizer are the main concerns in irrigated areas of these soils. Proper grazing use, timely deferment of grazing, and a planned grazing system are needed if these soils are used for rangeland. Proper timing of haying and proper mowing heights are needed if these soils are used for hay.

Sandy soils on bottom lands, stream terraces, and uplands

The soils in this group are deep, nearly level and very gently sloping, and somewhat poorly drained and somewhat excessively drained. Most of the acreage is cultivated and farmed dryland. A small acreage is in native grass and is used for grazing or hay. A few areas are sprinkler irrigated. Wetness in the spring and soil blowing in the summer and fall are the principal hazards. Maintaining soil fertility is the most important concern of management.

9. Elsmere-Thurman Association

Deep, nearly level and very gently sloping, somewhat poorly drained and somewhat excessively drained sandy soils that formed in eolian sands; on uplands, stream terraces, and bottom lands and in upland valleys

In this association the landscape consists mainly of nearly level, long, wide areas on uplands, stream terraces, and upland valley depressions. Slopes range from 0 to 3 percent.

This association occupies about 10,500 acres, or about 3 percent of the county. It consists of about 70 percent Elsmere soils, 15 percent Thurman soils, and 15 percent minor soils.

Elsmere soils formed in eolian sands in long, wide areas on stream terraces, bottom lands, and upland valley depressions. These soils are deep, nearly level, and somewhat poorly drained. Typically, the surface soil is very friable loamy fine sand about 16 inches thick. It is grayish brown in the upper part and dark gray in the lower part. The next layer is grayish brown, loose fine sand about 14 inches thick. The underlying material is light brownish gray and light gray fine sand to a depth of more than 60 inches.

Thurman soils formed in eolian sands on long, smooth areas on uplands and stream terraces. These soils are deep, nearly level and very gently sloping, and somewhat excessively drained. Typically, the surface soil is very friable loamy fine sand about 14 inches thick. The upper part is dark grayish brown, and the lower part is very dark grayish brown. The next layer is dark grayish brown, loose loamy fine sand about 4 inches thick. The underlying material is pale brown and brown fine sand to a depth of more than 60 inches.

Minor soils in this association are mainly of the Lawet, Libory, Loup, and Ovina series. Lawet and Loup soils are lower on the landscape than the Elsmere and Thurman soils and are poorly drained. Libory soils are on uplands above the Elsmere soils, but below the Thurman soils, and are moderately well drained. Ovina soils are on the same landscape as the Elsmere soils. Ovina soils have less sand in the profile than the Elsmere and Thurman soils.

Farms in this association are diversified, combining cash-grain and livestock operations. Much of the area is used for dryland crops, and the rest is in native grass that is used for grazing cattle or is mowed for hay. A few areas are irrigated by a sprinkler system. Corn, soybeans, grain sorghum, and alfalfa are the main crops grown. Watermelons, muskmelons, and pumpkins are also grown. This association is well suited to native grass because of subirrigation from the seasonal high water table. Cattle winter on forage crops.

Wetness and soil blowing are the main hazards. The somewhat poorly drained soils have a seasonal high water table that fluctuates between depths of 2 feet, in most wet years, and 4 feet, in most dry years. These

soils can be farmed in most years without tile drainage. Maintaining soil fertility and organic matter content are concerns of management in areas where the soils are used for crops. Distributing the proper amount of irrigation water and, at the same time, adequately controlling soil blowing are the main concerns if these soils are irrigated. Range management that includes proper grazing use, timely deferment of grazing, and a planned grazing system helps maintain the range condition. Proper mowing heights and proper timing of haying are essential if these soils are used for hay.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Nora silty clay loam, 2 to 6 percent slopes, is one of several phases in the Nora series.

Some map units, called soil complexes, are made up of two or more major soils. Each *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Inavale-Boel complex, 0 to 6 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits and dumps is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Some soil boundaries and soil names may not fully match those on maps of adjoining areas that were published at an earlier date. This is a result of changes and refinements in series concepts, different slope groupings, and application of the latest soil classification system.

Soil Descriptions

AcC—Alcester silty clay loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on foot slopes. This soil formed in silty colluvium. Individual areas of this soil range from 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 11 inches thick. The subsoil is friable silty clay loam about 30 inches thick. It is grayish brown in the upper part and brown in the lower part. The underlying material is pale brown, calcareous silt loam to a depth of more than 60 inches. In some places, the surface layer is 8 to 18 inches thick. Some small areas are nearly level.

Included with this soil in mapping are small areas of Hobbs, Nora, and Shell soils. Hobbs soils are on occasionally flooded upland drains, slightly lower on the landscape than the Alcester soil. Nora soils have a thinner surface layer and lime higher in the profile, and are on uplands above the Alcester soil. Shell soils are occasionally flooded and are lower on the landscape. The included soils make up about 10 to 20 percent of this map unit.

Permeability of this Alcester soil is moderate, and the available water capacity is high. The rate of water intake

is low. The organic matter content is moderate, and natural fertility is high. Runoff is medium. Tilth is fair. Good tillage is possible only within a limited range of soil moisture content. This soil releases moisture readily to plants.

Most of the acreage of this soil is in cultivated crops. Some of the acreage is in native grass used for hay or grazing. Some small areas are in windbreaks.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, oats, and alfalfa. Water erosion is the principal hazard on this soil. Conservation tillage practices, such as discing or chiseling, that keep crop residue on the surface help reduce erosion and control runoff. Terraces, contour farming, and grassed waterways also help to control erosion and protect the area against runoff from higher lying soils. Such practices as returning crop residue to the soil and including grasses and legumes in the cropping sequence help to maintain and improve the organic matter content and fertility.

If irrigated, this soil is suited to both gravity and sprinkler systems of irrigation. Crops commonly grown on the soil include corn, soybeans, and alfalfa. Water erosion is the main hazard. Bench leveling can be used to lower the effective gradient. Contour furrows are suited if they are used with terraces and grassed waterways and if an adequate amount of crop residue is kept on the surface. This soil needs to be protected against runoff from higher lying soils. Conservation tillage practices, such as discing or chiseling, and terraces and grassed waterways help to control runoff.

This soil is suited to introduced grasses for pasture. It is generally suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa. Pasture grasses can be used in sequence with row crops as part of the cropping system. Proper stocking and rotational grazing help to keep the desired grasses in good condition. Applying fertilizer and irrigation water can increase the growth and vigor of grasses.

This Alcester soil is well suited to trees and shrubs in windbreaks. Seedlings generally survive and grow if competing grasses and weeds are controlled. Undesirable weeds can be controlled by cultivating between the tree rows and by careful use of appropriate herbicides within the rows.

This soil is well suited to septic tank absorption fields. Foundations for dwellings need to be strengthened and backfilled with coarse materials to prevent damage by shrinking and swelling of the soil. The need to protect against runoff from higher lying areas should be considered in the construction of sanitary facilities, building sites, and roads or streets. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material helps to ensure better performance. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIe-1, dryland, and IIIe-3, irrigated, the Silty range site, and windbreak suitability group 3.

BdC—Bazile loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on uplands. This soil formed in loess over eolian sand or outwash sand. Individual areas of this soil range from 10 to 80 acres in size.

The surface layer is grayish brown very friable loam about 7 inches thick. The subsurface layer is dark grayish brown friable loam about 6 inches thick. The subsoil is brown, friable silty clay loam about 13 inches thick. The underlying material to a depth of more than 60 inches is pale brown loamy fine sand in the upper part and very pale brown fine sand in the lower part. Some small areas have a fine sandy loam surface layer.

Included with this soil in mapping are small areas of Loretto, Nora, and Thurman soils. Loretto and Nora soils have finer textured underlying material and are higher on the landscape than the Bazile soil. Thurman soils contain more sand in the surface and subsoil layers and are slightly higher on the landscape. The included soils make up about 10 to 15 percent of this map unit.

Permeability is moderately slow in the upper part of this Bazile soil and rapid in the lower part. Both the available water capacity and the rate of water intake are moderate. Organic matter content is moderate, and natural fertility is high. The surface layer is easily tilled throughout a wide range of moisture conditions. This soil releases water readily to plants.

Most of the acreage of this soil is used for cultivated crops. Some is in grass and is used for grazing or mowed for hay. Some small areas are in windbreaks.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, oats, and alfalfa. Water erosion is the main hazard. Because of the fine sand underlying material, this soil may be droughty. Conservation tillage practices, such as discing or chiseling, and terraces and waterways help to prevent water erosion. Returning crop residue to the soil and using feedlot manure help to maintain organic matter content and fertility.

Under irrigation, corn, soybeans, grain sorghum, and alfalfa can be grown on this soil. This soil is better suited to a sprinkler system than to other systems. It is suited to gravity irrigation if the soil is bench leveled or if contour furrows are supplemented by terraces and waterways. Deep cuts that expose the sandy underlying material should be avoided. Light, frequent applications of water are needed to prevent the leaching of water and nutrients below the root zone. Leaving an adequate amount of crop residue on the surface helps to reduce water erosion, which is the main hazard on this soil.

Runoff is an additional management concern. Conservation tillage practices, such as no-till planting or chiseling, keep all or most of the residue on the surface and thereby help to control water erosion. Applying feedlot manure helps to maintain organic matter content and fertility.

This soil is suited to introduced grasses used for pasture. Generally, it is suited to cool-season grasses, such as smooth brome or orchardgrass, mixed with alfalfa, as well as to warm-season grasses. Separate pastures of warm-season and cool-season grasses can be used for a long grazing season. Pasture plants can also be used in the cropping sequence with row crops. Overgrazing, grazing when the soil is wet, or haying at improper times or by improper methods reduces the protective cover and causes deterioration of the desired grasses. Proper stocking and rotational grazing help to keep the desired grasses in good condition. Applying nitrogen fertilizer and irrigation water can increase the vigor and growth of introduced grasses.

This Bazile soil is suited to rangeland, and using it for rangeland is an effective way to control water erosion. Management that allows overgrazing or haying at improper times or by improper methods reduces the protective cover and causes deterioration of the desired grasses. Planned grazing systems, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil is well suited to trees and shrubs in windbreaks. Competition for moisture from weeds and grasses is a management concern. Undesirable weeds and grasses can be controlled by cultivating between the tree rows and by using appropriate herbicides within the rows.

This soil readily absorbs the effluent from septic tank absorption systems, but it does not adequately filter the effluent. Care needs to be taken to assure that seepage does not contaminate the ground water or nearby streams. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. This soil is suited to the construction of dwellings. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance. Crowning the roadbed by grading and constructing adequate side ditches can provide good surface drainage and thus reduce damage to roads by frost action.

This soil is assigned to capability units IIIe-1, dryland, and IIIe-7, irrigated, the Silty range site, and windbreak suitability group 3.

Be—Belfore silty clay loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on broad upland ridgetops. This soil formed in loess. Individual areas of this soil range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsurface layer is also dark grayish brown, friable silty clay loam about 5 inches thick. The subsoil is about 35 inches thick. It is brown, firm silty clay in the upper part; brown, firm silty clay in the middle part; and yellowish brown and light olive brown, firm silty clay loam in the lower part. The underlying material to a depth of more than 60 inches is light yellowish brown silt loam. In a few small places the soil has a dark surface layer more than 20 inches thick and a thicker subsoil. Other small areas have less clay in the subsoil.

Included with this soil in mapping are small areas of Nora and Fillmore soils. Nora soils have less clay in the subsoil and are lower on the landscape than the Belfore soil. The poorly drained Fillmore soils are in shallow depressions and are slightly lower on the landscape. The included soils make up 3 to 10 percent of this map unit.

Permeability is moderately slow in this Belfore soil, and the available water capacity is high. Organic matter content is moderate, and natural fertility is high. Runoff is slow, and the rate of water intake is low. The surface layer can be easily tilled throughout only a fairly narrow range in moisture content. Shrink-swell potential is high.

Most of the acreage of this soil is cultivated. A small acreage is in pastureland.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, and oats. Alfalfa can be grown for hay and pasture. If this soil is tilled when wet, it becomes cloddy and hard upon drying. Repeated tillage when the soil is wet tends to cause the formation of a plowpan that slows the rate of water intake and penetration by the roots of most crops. Alfalfa roots help to break up this plowpan. Returning crop residue to the soil helps to improve tilth. Conservation tillage practices, such as discing or chiseling, keep crop residue on the surface and thereby help to keep the soil friable. No-till planting is suitable for row crops. Lime is generally needed for legumes.

If irrigated, this soil is suited to both gravity and sprinkler irrigation systems. Corn, soybeans, grain sorghum, and alfalfa can be grown. Tilling the soil when it is wet compacts the surface layer and slows the rate of water intake. Alfalfa roots help to increase the rate of water intake. Land leveling is generally needed to improve surface drainage and increase the efficiency of the irrigation system. Irrigation water should be applied in sufficient amounts to serve the needs of the crop and at a rate that permits maximum absorption and minimum runoff. Lime is generally needed for legumes.

This soil is suited to introduced grasses for pasture. Cool-season species, such as smooth brome or orchardgrass, can be mixed with alfalfa. Pasture grasses can also be used as part of a cropping sequence that includes row crops. Proper stocking and rotational

grazing help to keep the desired grasses in good condition. Applying nitrogen fertilizer and irrigation water can help maintain fertility and increase the growth and vigor of grasses.

This Belfore soil is well suited to most species of trees and shrubs that can tolerate the climate. Competition from undesirable grasses and weeds is a concern and can be controlled by cultivation between the tree rows and by careful use of appropriate herbicides or by roto-tilling within the rows.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this limitation can generally be overcome by increasing the size of the absorption area. Foundations for dwellings need to be strengthened and backfilled with coarse materials to prevent damage by shrinking and swelling of the soil. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse-grained material for subgrade or base material can ensure better road performance. In addition, base material can be mixed with additives, such as hydrated lime, to help prevent shrinking and swelling.

This soil is assigned to capability units I-1, dryland, and I-3, irrigated, the Clayey range site, and windbreak suitability group 3.

Bn—Blendon fine sandy loam, 0 to 2 percent slopes. This deep, well drained, nearly level soil is on stream terraces. This soil formed in mixed eolian sands and alluvium. Individual areas range from 5 to 150 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 10 inches thick. The subsoil is about 28 inches thick. The upper part is very dark gray, very friable fine sandy loam, and the lower part is dark grayish brown, very friable fine sandy loam. The underlying material is pale brown loamy fine sand to a depth of more than 60 inches. In some small areas, the upper part of the surface layer is loamy fine sand; other small areas have a loam surface layer. Some small areas have a brown subsoil.

Included with this soil in mapping are small areas of Boelus, Loretto, and Thurman soils. Boelus and Loretto soils have more clay in the subsoil than the Blendon soil and are on slightly higher or similar landscapes. Thurman soils have more sand in the surface layer and subsoil and are on similar landscapes. The included soils make up about 5 to 10 percent of this map unit.

Permeability is moderately rapid in the subsoil of this Blendon soil and rapid in the underlying material. The available water capacity is moderate. Organic matter content is moderate, and natural fertility is high. Runoff is slow. The rate of water intake is moderately high. The surface layer is easily tilled through a wide range of moisture conditions. This soil absorbs moisture readily and releases it readily to plants.

Most of the acreage of this soil is cultivated. A few areas are in native or introduced grass and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, oats, and alfalfa. Soil blowing is the main hazard. The principal concern of management is maintaining the fertility and organic matter content of the soil. Conservation tillage practices, such as discing or chiseling, keep crop residue on the surface and help to prevent soil blowing and the evaporation of soil moisture. Use of cover crops is also helpful.

If irrigated, this soil is suited to gravity and sprinkler systems. It is suited to corn, grain sorghum, soybeans, and alfalfa. Land leveling is generally needed for gravity irrigation, but deep cuts should be avoided. Returning crop residue to the soil and applying feedlot manure help to control soil blowing. Conservation tillage practices, such as no-till planting, keep crop residue on the surface and thereby help to control soil blowing (fig. 6). The amount of water applied in irrigation should be controlled to prevent leaching of nutrients.

This soil is suited to introduced grasses for pasture. Cool-season grasses, such as smooth brome and orchardgrass, can be mixed with alfalfa. A cropping sequence can be used that alternates grasses and row crops. Overgrazing reduces the protective cover and causes deterioration of the desired grasses. Proper stocking and rotational grazing help to keep the desired grasses in good condition. Adding nitrogen fertilizer and irrigation water helps to improve the vigor and growth of pasture grasses.

This soil is fairly well suited to trees and shrubs in windbreaks. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation should be restricted to between the tree rows. Appropriate herbicides can be applied or the soil can be roto-tilled to control weeds and grasses within the rows.

This Blendon soil readily absorbs the effluent from septic tank absorption systems, but it does not adequately filter the effluent. Care needs to be taken to assure that seepage does not contaminate the ground water. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. This soil is suited to construction of small commercial buildings and dwellings. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the roadbed by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIs-6, dryland, and IIe-8, irrigated, the Sandy range site, and windbreak suitability group 5.

Bp—Boel fine sandy loam, 0 to 2 percent slopes. This deep, somewhat poorly drained, nearly level soil is on bottom lands of the major stream valleys. It is subject

Figure 6.—Conservation tillage helps to control soil blowing on this Blendon fine sandy loam.

to occasional flooding. This soil formed in sandy and loamy alluvium. Individual areas of this soil range from 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 6 inches thick. The subsurface layer is dark gray, very friable fine sandy loam about 5 inches thick. The next layer is grayish brown, very friable fine sandy loam about 4 inches thick. The underlying material is mottled fine sand. It is light brownish gray in the upper part and light gray or white in the lower part to a depth of more than 60 inches. Some small areas have a loamy fine sand surface layer, and other small areas have a loam surface layer.

Included with this soil in mapping are small areas of Cass, Gibbon, Inavale, and Ord soils. Cass soils are well drained and are slightly higher on the landscape than the Boel soil. Inavale soils are somewhat excessively drained, have less silt in the upper part of the profile, and are slightly higher on the landscape. Gibbon and Ord soils have less sand in the upper part of the profile and are on slightly higher landscapes. The included soils make up 5 to 15 percent of this map unit.

Permeability is rapid in this Boel soil. The rate of water intake is moderately high, and the available water capacity is low. This soil has a seasonal high water table that fluctuates from a depth of about 1.5 feet in most wet years to about 3.5 feet in most dry years. Organic matter content is moderately low, and natural fertility is medium. Runoff is slow. The surface layer is easily tilled throughout a fairly wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is in grass and is used for grazing or mowed for hay. In some areas adjacent to river channels, trees and shrubs are the dominant vegetation. Some areas are used for cultivated crops, and a small acreage is irrigated.

This soil is suited to dryland farming. Corn, grain sorghum, soybeans, and legumes are suited. Spring-sown small grains are generally not grown because of wetness, which delays tilling and planting in spring. Conservation tillage practices, such as discing or chiseling, keep crop residue on the surface and thereby help to prevent evaporation of soil moisture. Floodwater can be controlled by dikes and levees.

If irrigated, this soil is suited to both gravity and sprinkler systems. Corn, sorghum, and alfalfa can be grown under irrigation. Land leveling is generally needed, but deep cuts that expose the fine sand underlying material need to be avoided. Because of the coarse textured underlying material, the length of the runs

needs to be short under gravity irrigation. Frequent, light applications of water help to prevent the leaching of water and herbicides through the soil. In some areas drainage ditches help to lower the water table and improve tillage in spring. Returning crop residue to the soil and applying feedlot manure help to improve the organic matter content and fertility and prevent evaporation of soil moisture.

This soil is suited to introduced grasses for use as pasture or hay. It is suited to cool-season grasses, such as reed canarygrass and creeping foxtail, as well as to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Overgrazing reduces the protective cover and causes deterioration of desired grasses. Proper stocking and rotational grazing help to maintain the desired grasses. Applying nitrogen fertilizers and irrigation water increases the growth and vigor of grasses.

This Boel soil is suited to native grasses that can tolerate the seasonal high water table. Such practices as overgrazing or untimely mowing or haying reduce the protective cover and cause deterioration of the native plants. In addition, overgrazing when the soil is wet causes compaction and makes it difficult for animals to graze or hay to be harvested. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Species selected should be able to tolerate occasional wetness. Establishing seedlings can be difficult in the spring of wet years. The soil should be tilled and seedlings planted after the soil has begun to dry. Undesirable weeds and grasses can be controlled by cultivating between the tree rows and by using appropriate herbicides or roto-tilling within the rows. Areas near the trees can be hoed by hand.

This soil is not suited to septic tank absorption fields because of wetness, flooding, and poor filtering capacity of the underlying material. A suitable alternate site is needed. This soil is not suited to use as a building site because of the hazard of flooding and wetness. A suitable alternate site is needed. If roads are constructed on this soil, side ditches and culverts are needed, and suitable fill material should be used, to help prevent flood damage and wetness.

This soil is assigned to capability units IIIw-6, dryland, and IIIw-8, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

Br—Boel loamy fine sand, channeled. This deep, somewhat poorly drained soil is on channeled bottom lands that are subject to frequent flooding. Channels 3 to 5 feet deep are common. This soil formed in sandy alluvium, and areas of this soil range from 10 to 40 acres in size.

Typically, the surface layer is grayish brown, friable loamy fine sand about 8 inches thick. The next layer is dark grayish brown, friable loamy fine sand about 5 inches thick. The underlying material is mottled, grayish brown loamy fine sand in the upper part and mottled, light brownish gray fine sand in the lower part to a depth of more than 60 inches. Some small areas are poorly drained.

Included with this soil in mapping are small areas of Inavale and Ord soils. Inavale soils are somewhat excessively drained and are slightly higher on the landscape than the Boel soil. Ord soils have less sand in the upper part of the profile and are higher on the landscape. The included soils make up about 5 to 20 percent of this map unit.

Permeability is rapid in this Boel soil, and the available water capacity is low. This soil has a seasonal water table that fluctuates from a depth of 0.5 foot in most wet years to a depth of 2.5 feet in most dry years. Organic matter content is low, and natural fertility is low. Runoff is slow. This soil releases moisture readily to plants.

Most of the acreage of this soil is in grass that is used for grazing or mowed for hay. Some areas have scattered trees.

This soil is not suited to cultivated crops, dryland or irrigated, because of frequent flooding and channeling.

This soil is suited to rangeland, for either grazing or haying. Cutbanks can be backsloped to improve access for mowing and grazing where the channels are too steep. Overgrazing, untimely haying, or mowing at improper heights reduces the protective cover and causes deterioration of the native grasses. Proper grazing use, timely deferment of grazing or haying, and restricting use during very wet periods help to maintain the native plants in good condition.

This soil generally is poorly suited to trees in windbreaks and to recreation or wildlife plantings. Specialized plantings and special treatment, such as hand planting, scalp planting, and specialized site preparation, can be effective in some areas.

This Boel soil is not suited to septic tank absorption fields or to use as a building site because of frequent flooding and wetness. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above the flood level and providing adequate side ditches and culverts help to protect roads from flood damage and wetness.

This soil is assigned to capability unit Vw-7, the Subirrigated range site, and windbreak suitability group 10.

BsC—Boelus loamy fine sand, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on uplands where a layer of sand has blown over loess. Individual areas of this soil range from 5 to 75 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 7 inches thick. The subsurface layer is dark grayish brown, very friable loamy fine sand about 7 inches thick. The next layer is grayish brown, very friable loamy fine sand about 10 inches thick. The subsoil is friable silty clay loam about 26 inches thick. It is pale brown in the upper part and light yellowish brown in the lower part. The underlying material is very pale brown silt loam to a depth of more than 60 inches. In a few small areas, the surface layer is fine sand. Some small areas have steeper slopes. In some areas the sandy material is less than 20 inches thick.

Included with this soil in mapping are small areas of Loretto, Nora, and Thurman soils. Loretto soils have more clay in the surface layer than the Boelus soil and are on similar landscapes. Nora soils have more clay in the surface layer and subsoil and are lower on the landscape. Thurman soils have more sand in the subsoil, and they are higher on the landscape. The included soils make up 10 to 15 percent of this map unit.

Permeability is rapid in the upper part of this Boelus soil and moderate in the lower part. Runoff is slow. The available water capacity and the rate of water intake are high. Organic matter content is moderately low, and natural fertility is medium. The surface layer is easily tilled throughout a wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is in cultivated crops. A few areas are in introduced and native grasses and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, oats, and alfalfa. Soil blowing and water erosion are the main hazards. Conservation tillage practices, such as discing and chiseling, keep crop residue on the surface and thereby help to lessen soil blowing and the evaporation of soil moisture. A no-till planting system can be used for row crops. Terraces, grassed waterways, and contour farming help to prevent water erosion. Use of feedlot manure helps improve the soil's organic matter content and fertility.

If irrigated, this soil is better suited to sprinkler systems than to other systems. Under irrigation, it is suited to corn, soybeans, grain sorghum, and alfalfa. Soil blowing and water erosion are the main hazards. Maintaining fertility is an important concern of management. Bench leveling helps to increase the efficiency of irrigation systems. Conservation tillage systems, such as discing and chiseling, that keep crop residue on the surface during and after planting help to control soil blowing and water erosion. Contour furrows are suited if they are used with terraces and grassed waterways and if an adequate amount of crop residue is left on the surface.

Use of this Boelus soil for introduced pasture grasses is an effective way to control erosion. The soil is suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Introduced grasses can be used as part of a cropping sequence that includes row crops. Overgrazing reduces the protective cover and causes deterioration of the desired grasses. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water can increase the growth and vigor of pasture grassses.

This soil is suited to native grasses that are used for rangeland, and using this soil for range is an effective way to control soil blowing. Overgrazing, untimely haying, or mowing at improper heights reduce the protective cover and cause deterioration of desired grasses. Reducing protective cover can cause severe losses by soil blowing. A planned grazing system, proper grazing use, and timely deferment of grazing help to maintain or improve the range condition.

This soil generally is fairly well suited to trees and shrubs in windbreaks. Insufficient moisture and soil blowing are the principal concerns of management. Planting a cover crop between the rows helps to prevent soil blowing. Undesirable grasses and weeds can be controlled by cultivation between the tree rows and by careful use of appropriate herbicides or roto-tilling within the rows.

This soil readily absorbs the effluent from septic tank absorption systems. Foundations for dwellings need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance.

This soil is assigned to capability units IIIe-6, dryland, and IIIe-10, irrigated, the Sandy range site, and windbreak suitability group 5.

Cf—Cass fine sandy loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on bottom lands along major stream valleys. This soil formed in stratified loamy and sandy alluvium. This soil is subject to occasional flooding. Areas range from 3 acres to several hundred acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 6 inches thick. The subsurface layer is dark grayish brown, very friable fine sandy loam about 13 inches thick. The next layer is grayish brown, very friable fine sandy loam about 9 inches thick. The underlying material is light brownish gray, loamy fine sand in the upper part, grayish brown loam in the middle part, and light gray fine sand in the lower part to a depth of more than 60 inches. Stratification is common in the underlying material. In some areas, the upper part of the surface layer is loamy fine sand. In other small areas, the surface layer is loam.

Included with this soil in mapping are small areas of Boel, Inavale, and Ord soils. Boel and Ord soils are somewhat poorly drained and slightly lower on the landscape than the Cass soil. Inavale soils have more sand in the surface layer and subsoil, and they are on the same landscape. The included soils make up about 5 to 15 percent of this map unit.

Permeability is moderately rapid in this Cass soil, the rate of water intake is moderately high, and the available water capacity is moderate. Organic matter content is moderately low, and natural fertility is medium. Runoff is slow. The surface layer is easily tilled throughout a fairly wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is in cultivated crops. A few areas are in native grass used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, and alfalfa. The main hazards are droughtiness and soil blowing. Maintaining fertility is a concern of management. Conservation tillage practices, such as discing or chiseling and no-till planting, keep crop residue on the surface and thereby help to prevent soil blowing and conserve soil moisture. Use of cover crops is also helpful. Returning crop residue to the soil helps to control soil blowing, maintain the content of organic matter, and improve the fertility of the soil.

Under irrigation, corn, soybeans, grain sorghum, and alfalfa can be grown. This soil is suited to both gravity and sprinkler systems of irrigation. Land grading increases the efficiency of irrigation systems, but if the land is graded, deep cuts should be avoided. Because of the underlying material of fine sand, light, frequent applications of water and short length of runs are needed to prevent the leaching of plant nutrients and herbicides below the depth of plant roots. Conservation tillage practices, such as discing or chiseling, help to prevent soil blowing. Keeping crop residue on the surface and applying feedlot manure help to maintain the content of organic matter and improve fertility.

This soil is suited to cool-season grasses, such as smooth brome, tall fescue, or orchardgrass, mixed with alfalfa. It is also suited to warm-season grasses. Introduced grasses can be used as part of a cropping sequence that includes row crops. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Overgrazing reduces the protective plant cover and causes deterioration of the desired grasses. Proper stocking and rotational grazing help to keep the desired grasses in good condition. Application of nitrogen fertilizer commonly increases the growth and vigor of introduced grasses.

This soil is suited to use as rangeland, and this use is an effective way to control soil blowing. Overgrazing reduces the protective cover and causes deterioration of desired grasses. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil is well suited to trees and shrubs in windbreaks. Sod or a cover crop can be established between the rows to help control soil blowing. Cultivation or appropriate herbicides may be used to control grass and weeds.

This soil is not suited to septic tank absorption fields or to dwellings because of flooding. Suitable alternate sites are needed. The walls or sides of shallow excavations should be temporarily shored to prevent sloughing or caving. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect roads from flood damage. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIw-3, dryland, and IIw-8, irrigated, the Sandy Lowland range site, and windbreak suitability group 1.

Cg—Cass loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on bottom lands along major stream valleys. This soil formed in stratified loamy and sandy alluvium. This soil is occasionally flooded. Individual areas range from 3 to 50 acres in size.

Typically, the surface layer is dark grayish brown, very friable loam about 7 inches thick. The subsurface layer is dark grayish brown, very friable fine sandy loam about 8 inches thick. The next layer, a transition layer, is grayish brown, friable fine sandy loam about 11 inches thick. The underlying material is brown loamy fine sand in the upper part, grayish brown fine sandy loam in the middle part, and pale brown fine sand in the lower part to a depth of more than 60 inches. Stratified layers of loam and silt loam are common in the underlying material. In some small areas, the surface layer is fine sandy loam or silt loam. In other small areas, the surface layer is thicker than 20 inches. Other small areas have a loam transition layer.

Included with this soil in mapping are small areas of Boel, Ord, and Shell soils. The somewhat poorly drained Boel and Ord soils are slightly lower on the landscape than the Cass soil. Shell soils have more clay in the upper part of the profile and are on similar landscapes. The included soils make up about 5 to 10 percent of this map unit.

Permeability is moderately rapid in this Cass soil. The rate of water intake is moderately high, and the available water capacity is moderate. Organic matter content is moderate, and natural fertility is medium. Runoff is slow. The surface layer is very friable and easily tilled throughout a fairly wide range of moisture conditions. This soil absorbs moisture readily and releases it readily to plants.

Most of the acreage of this soil is cultivated. A few areas are in grass and are used for hay and grazing.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, and legumes. The need to maintain organic matter content and fertility and the moderate available water capacity are the main management concerns. Conservation tillage practices, such as discing, that keep crop residue on the surface help to maintain organic matter content and fertility. Use of cover crops is also helpful.

Under irrigation, corn, soybeans, grain sorghum, and alfalfa can be grown. This soil is suited to both gravity and sprinkler systems of irrigation. If land grading is needed, deep cuts should be avoided. Land leveling can increase the efficiency of irrigation systems. Because of the fine sand underlying material and the moderately high intake rate, light and frequent applications of water and short lengths of run are needed to prevent the leaching of fertilizer and herbicides below the depth of plant roots. Conservation tillage practices, such as discing, help to prevent evaporation of moisture. Keeping crop residue on the surface and applying feedlot manure help to maintain fertility.

This soil is suited to introduced grass pastures. This soil is well suited to cool-season grasses, such as smooth brome, tall fescue, or orchardgrass, mixed with alfalfa. It is also suited to warm-season grasses. Pastures can be used as part of a cropping sequence that alternates with row crops. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Overgrazing or improper haying methods reduce the plant cover and cause deterioration of the desired grasses. Rotational grazing and proper stocking help to keep desired grasses in good condition. Applying nitrogen fertilizer improves the growth and vigor of pastures.

This Cass soil is suited to native grass that is used for range. Using this soil for rangeland is an effective way to control soil blowing. Overgrazing by livestock or haying by improper methods reduces the protective cover and causes deterioration of desired grasses. A planned grazing system, proper grazing use, and timely deferment of grazing help to keep desired grasses in good range condition.

This soil generally is well suited to trees and shrubs in windbreaks. The main limitation is competition for moisture from weeds and grasses. Weeds and grasses can be controlled by cultivation between the tree rows and by hand hoeing or using appropriate herbicides within the rows.

This soil is not suited to septic tank absorption fields or to dwellings because of flooding. Suitable alternate sites are needed. The walls or sides of shallow excavations should be temporarily shored to prevent sloughing or caving. Constructing roads on suitable, compacted fill material, crowning the roadbed, and providing adequate side ditches and culverts help to protect roads from flood damage and frost action.

This soil is assigned to capability units IIw-3, dryland, and IIw-6, irrigated, the Sandy Lowland range site, and windbreak suitability group 1.

CnC—Clarno loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on side slopes of uplands. It formed in glacial till. Individual areas range from 3 to 80 acres in size.

Typically, the surface layer is dark grayish brown, very friable loam about 7 inches thick. The subsurface layer is dark grayish brown, very friable loam about 5 inches thick. The subsoil is about 24 inches thick. It is brown, firm clay loam in the upper part and light brownish gray, mottled, firm clay loam in the lower part. The underlying material is light yellowish brown, mottled clay loam to a depth of more than 60 inches. Depth to lime is 23 inches. Some small areas contain reddish material in the subsoil and underlying material. Other small areas have a surface soil less than 7 inches thick, and other small areas have a fine sandy loam surface layer. Other small areas have steeper slopes.

Included with this soil in mapping are small areas of Hadar and Thurman soils. Hadar soils have a loamy fine sandy surface layer and are slightly higher on the landscape than this Clarno soil. Thurman soils are somewhat excessively drained and are higher on the landscape. The included soils make up about 10 to 15 percent of this map unit.

Permeability is moderately slow in this Clarno soil, and the available water capacity is high. Organic matter content is moderately low, and natural fertility is medium. The rate of water intake is moderately low. Runoff is medium. The surface layer is easily tilled throughout a fairly wide range of moisture conditions. This soil releases water readily to plants. Shrink-swell potential is moderate.

Most of the acreage of this soil is cultivated. A few areas are in pasture and rangeland and are used for grazing or mowed for hay. A few areas are used for homesites.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, and alfalfa. The principal hazard is water erosion. Maintaining the fertility and organic matter content of this soil are concerns of management. Terraces, contour farming, and grassed waterways can be used to control runoff and erosion. Conservation tillage practices, such as chiseling and discing, that keep crop residue on the surface help to prevent water erosion. Returning crop residue to the soil also helps to maintain fertility and improve tilth.

If irrigated, this soil is suited to corn, grain sorghum, soybeans, and alfalfa. It is suited to a sprinkler irrigation system. It is also suited to a gravity system if the site is bench leveled or contour furrowed, if terraces and grassed waterways are used, and if an adequate amount

of crop residue is kept on the surface. Water erosion and runoff are concerns of management. The rate of water application should be carefully controlled. Conservation tillage practices, such as chiseling or discing, can help prevent water erosion and runoff. Returning crop residue to the soil and applying feedlot manure help to maintain organic matter content and fertility and improve tilth.

Use of this soil for pasture is an effective way to control erosion. Cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, can be mixed with alfalfa. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Introduced grasses can be used in a cropping sequence with row crops. Overgrazing or grazing when the soil is wet reduces the protective cover and causes deterioration of the desired grasses. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water increases the growth and vigor of grasses.

This Clarno soil is suited to native grasses or rangeland. Use of this soil for range is an effective way to help control erosion. Overgrazing and untimely haying, and use of improper mowing heights reduce the protective plant cover and cause deterioration of the native plants. A planned grazing system, proper grazing use, timely deferment of grazing, and restricting use during very wet periods help to maintain the desired range condition.

This soil is fairly well suited to trees and shrubs in windbreaks. Competition for moisture from weeds and grass is the main management concern. Cultivation between the rows or careful use of appropriate herbicides can help to control weeds and grasses. Planting trees on the contour and terracing help control erosion and runoff.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this limitation can generally be overcome by increasing the size of the absorption field. Foundations of dwellings need to be strengthened and backfilled with coarse materials to prevent damage caused by shrinking and swelling of the soil. Roads should be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse-grained material for subgrade or base material can ensure better performance.

This soil is assigned to capability units IIe-1, dryland, and IIIe-4, irrigated, the Silty range site, and windbreak suitability group 3.

Co—Colo silty clay loam, 0 to 1 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottom lands of major creeks. This soil formed in noncalcareous silty alluvium, and it is subject to occasional flooding. Individual areas of this soil range from 10 to 100 acres in size.

Typically, the surface layer is dark gray, friable silty clay loam about 8 inches thick. The subsurface layer is firm silty clay loam about 28 inches thick. It is dark gray in the upper part and very dark gray in the lower part. Next is a layer of dark gray, firm silty clay loam about 8 inches thick. The underlying material is grayish brown, mottled silty clay loam to a depth of more than 60 inches. Some small areas have a stratified grayish brown and dark grayish brown thin surface layer of recent overwash material.

Included with this soil in mapping are small areas of Lamo, Hobbs, and Shell soils. Lamo soils have lime above 10 inches and are on similar landscapes. The well drained Hobbs and Shell soils are slightly higher on the landscape. The included soils make up about 10 to 20 percent of this map unit.

Permeability is moderately slow in this Colo soil, and the available water capacity is high. Runoff is slow. This soil has a seasonal high water table that is at a depth of about 2 feet in most wet years and about 3 feet in most dry years. The water table is generally highest in early spring. Organic matter content and natural fertility are high. The rate of water intake is low. The surface layer is easily tilled only throughout a fairly narrow range in moisture content. This soil releases moisture readily to plants.

A few areas are cultivated. Most of the acreage is in introduced grass or native grass and is used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, soybeans, sorghum, and alfalfa. Wetness is the main limitation, and generally delays tillage in the spring. Tile drains can be installed or V-shaped drainage ditches can be constructed to help lower the water table if suitable outlets are available. Conservation tillage practices, such as discing, keep crop residue on the surface and thereby help to prevent crusting and evaporation of soil moisture.

If irrigated, this soil is suited to both gravity and sprinkler irrigation systems. Corn, grain sorghum, soybeans, and alfalfa can be grown under irrigation. Tillage is commonly delayed in spring of most years. Perforated tile can be installed or V-shaped drainage ditches can be constructed to improve drainage if a suitable outlet is available. Land leveling helps to improve surface drainage and increases the efficiency of the irrigation system. Returning crop residue to the surface and applying feedlot manure help to maintain fertility and improve tilth.

This soil is suited to introduced grasses used for pasture. Proper stocking and rotational grazing help to keep the grass in good condition. This soil is suited to cool-season grasses, such as reed canarygrass and creeping foxtail, as well as to warm-season grasses. Overgrazing reduces the vegetative cover and encourages the growth of weeds and forbs. Grazing when the soil is wet causes compaction, making it

difficult for animals to graze. Applying nitrogen fertilizer increases the growth and vigor of grass.

This soil is suited to native grasses that are used for grazing or haying. Using this soil for rangeland requires proper management of grazing or haying. Overgrazing, untimely haying, and the use of improper mowing heights reduce the plant cover and cause deterioration of the native plants. When the soil is wet, overgrazing can cause surface compaction, making it difficult for animals to graze or hay to be harvested. Proper grazing use, restricting use during wet periods, and scheduling timely deferment of grazing or haying help to maintain the grasses in good condition.

This soil is well suited to trees and shrubs that can tolerate wetness from the seasonal high water table and occasional flooding. Competition from undesirable grasses and weeds is a common concern in windbreaks. These can be controlled by cultivation and by careful use of appropriate herbicides. Establishment of seedlings can be difficult during wet years.

This Colo soil is generally not suited to septic tank absorption fields and dwellings because of wetness caused by the seasonal high water table and flooding. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect roads from flooding and wetness. Roads should be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material ensures better performance.

This soil is assigned to capability units IIw-4, dryland, and IIw-3, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

CrC2—Crofton silt loam, 2 to 6 percent slopes, eroded. This deep, well drained, gently sloping soil is on narrow ridges of the uplands. This soil formed in loess. Small gullies and rills are common after heavy rains. Areas range from 5 to 20 acres in size.

Typically, the surface layer is brown, very friable, calcareous silt loam about 6 inches thick. The next layer is pale brown, very friable, calcareous silt loam about 6 inches thick. The underlying material is calcareous silt loam to a depth of more than 60 inches. It is pale brown in the upper part and pale yellow in the lower part. Lime concretions are common on the surface. In some areas, the original surface layer has been eroded away, and the parent loess is at the surface. In a few small areas, the soil has slopes of 6 to 11 percent.

Included with this soil in mapping are small areas of Moody and Nora soils. Moody and Nora soils have a thicker surface layer, have lime deeper in the profile, and are on a landscape similar to that of the Crofton soil. The included soils make up about 10 to 20 percent of this map unit.

Permeability is moderate in this Crofton soil, and the available water capacity is high. Runoff is medium. Organic matter content and natural fertility are low. The rate of water intake is moderate. The surface layer is easily tilled throughout a fairly wide range of moisture conditions. This soil releases water readily to plants. This soil generally is low in nitrogen, phosphorus, and zinc.

Nearly all the acreage of this soil is cultivated. A few areas are seeded to introduced grass and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, oats, and alfalfa. Water erosion is difficult to control if the soil is used for row crops. Conservation tillage practices, such as discing or chiseling and stubble mulching, keep crop residue on the surface and thereby help to control water erosion and prevent excessive loss of soil moisture. Contour stripcropping also helps to control erosion, and returning crop residue to the soil helps to maintain organic matter content and fertility. Applying feedlot manure helps to improve fertility.

If irrigated, this soil is suited to sprinkler systems. If the soil is bench leveled or terraced and contour furrowed, it is suited to gravity systems. This soil is suited to corn, grain sorghum, soybeans, and alfalfa. Water erosion, runoff, and low fertility are concerns of management. Conservation tillage practices, such as discing or chiseling, keep crop residue on the surface and thereby help to control water erosion and runoff. Terraces and grassed waterways are also helpful. Irrigation water needs to be carefully controlled. Returning crop residue to the soil and applying feedlot manure help to improve fertility and organic matter content of the soil.

If this soil is used for pasture, it is generally suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Pastures can be used in a cropping sequence with row crops. Overgrazing reduces the protective cover and causes deterioration of the desired grasses. Proper stocking, rotational grazing, and weed control help to keep the grasses in good condition.

If this soil is used as a site for windbreaks, it should be planted to trees and shrubs that can tolerate a high content of lime. Water erosion is the main hazard. Moisture competition between plants is the main limitation to the establishment of seedlings. Seedlings of common species generally survive and grow if weeds and undesirable grasses are controlled. Weeds can be controlled by good site preparation and by timely cultivation between the tree rows. Water erosion can be controlled if terraces are used and tree rows are planted on the contour.

This soil is suited to septic tank absorption fields and dwellings. Roads should be designed so that the surface pavement and base are thick enough to compensate for

the low strength of the soil material. Using coarse grained material for the subgrade material ensures better performance.

This soil is assigned to capability units IIIe-8, dryland, and IIIe-6, irrigated, the Limy Upland range site, and windbreak suitability group 8.

CrD2—Crofton silt loam, 6 to 11 percent slopes, eroded. This deep, well drained, strongly sloping soil is on narrow ridgetops and short, uneven side slopes of the uplands. This soil formed in loess. Small gullies and rills are common after heavy rains. Erosion has not been uniform, and in places, most of the original surface layer has been eroded away. Individual areas range from 3 to 70 acres in size.

Typically, the surface layer is brown, very friable, calcareous silt loam about 5 inches thick. The next layer is brown, very friable, calcareous silt loam about 4 inches thick. The underlying material is pale brown, calcareous silt loam to a depth of more than 60 inches. Lime concretions are common on the surface. Depth to lime ranges from 0 to 8 inches. In some small areas, the soil has a darker surface layer.

Included with this soil in mapping are small areas of the better developed Nora soil, mainly on side slopes below the Crofton soils. The included soils make up 5 to 15 percent of this map unit.

Permeability is moderate in this Crofton soil, and the available water capacity is high. Runoff is rapid. Organic matter content and natural fertility are low. The rate of water intake is moderate. Because of the high content of lime, this soil is low in available phosphorus and zinc. The surface layer is easily tilled through a fairly wide range of moisture conditions. This soil releases moisture readily to plants.

Nearly all of the acreage of this soil is in cultivated crops. A few small areas are in native grass or are seeded to introduced grasses.

This soil is poorly suited to dryland crops because of the strong slopes and the hazard of erosion. Under dryland farming, this soil is suited to corn, grain sorghum, oats, and alfalfa. Water erosion is the principal hazard. Reducing loss of moisture by runoff and maintaining fertility are management concerns. Conservation tillage practices, such as discing, chiseling, or no-till planting, keep crop residue on the surface and thereby help to control erosion and runoff. Keeping crop residue on the surface also helps to improve the organic matter content and conserve soil moisture. Some areas of smoothly sloping soils can be terraced and cultivated on the contour. Adding phosphate and zinc fertilizer and feedlot manure helps improve soil fertility.

If irrigated, this soil is poorly suited to row crops because of the strong slopes and high risk of erosion. It is better suited to close-grown crops, such as alfalfa. Row crops, such as corn, can be grown if they are carefully managed. A sprinkler system is the most suitable method of irrigation for this soil. A proper rate of water application is needed.

In irrigated areas of this soil, water erosion is the main hazard. Controlling runoff and improving fertility are management concerns. Conservation tillage practices, such as chiseling or discing, that keep crop residue on the surface are important because they help control erosion and runoff and conserve soil moisture. Terraces, contour farming, and grassed waterways can be used to help control erosion and runoff. Applying feedlot manure helps maintain organic matter content and soil fertility.

This Crofton soil is suited to introduced grasses for pasture. Pastures generally consist of cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa. Using this soil for pasture is an effective way to control erosion. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Pasture grasses can be used in rotation with row crops as part of a cropping system. Overgrazing reduces the protective cover and causes deterioration of the stand of grasses. Proper stocking and rotational grazing help to keep desired grasses in good condition. Application of fertilizers and feedlot manure helps increase the vigor and growth of grasses.

This soil is suited to range, and using it for range is an effective way to control erosion. Overgrazing, untimely haying, and the use of improper mowing heights reduce the protective cover and cause deterioration of the desired grasses. Reducing the protective grass cover can result in severe soil losses by water erosion. A planned grazing system, proper grazing use, and timely deferment of grazing help to maintain or improve the range condition. Range seeding may be needed to stabilize the soil in areas of severely eroded cropland.

This soil is fairly suited to trees and shrubs in windbreaks. Only tree and shrub species that can tolerate a high amount of calcium in the soil can be grown on this soil. Water erosion and insufficient moisture are the main management concerns. Planting trees on a terraced contour enables the soil to store moisture and helps to control erosion. Weeds between the rows can be controlled by cultivation, and weeds in the rows can be controlled by careful use of appropriate herbicides or hoeing by hand. Supplemental water may be needed during periods of inadequate rainfall.

Land shaping and installing the distribution lines on the contour are needed to ensure proper operation of septic tank absorption fields on this soil. Dwellings need to be properly designed to accommodate the slope, or the soil can be graded. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material ensures better performance. Cutting and filling are generally needed to provide a suitable grade.

This soil is assigned to capability units IVe-8, dryland, and IVe-6, irrigated, the Limy Upland range site, and windbreak suitability group 8.

CrF—Crofton silt loam, 15 to 30 percent slopes. This deep, somewhat excessively drained, steep soil is on short side slopes of the uplands. This soil formed in loess. Individual areas range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, very friable silt loam 5 inches thick. The next layer is pale brown, very friable silt loam 5 inches thick. The underlying material is calcareous silt loam. It is pale brown in the upper part and light yellowish brown in the lower part to a depth of more than 60 inches. Depth to free carbonates ranges from 0 to 8 inches. In a few cultivated areas the surface layer is eroded and calcareous material is on the surface. In some small areas the slopes are 11 to 15 percent.

Included with this soil in mapping are small areas of Nora and Thurman soils. The well drained Nora soils are lower on the landscape than the Crofton soil. The sandy Thurman soils are on similar landscapes. The included soils make up 10 to 15 percent of this map unit.

Permeability is moderate in this Crofton soil, and the available water capacity is high. Runoff is rapid. Organic matter content is moderately low, and natural fertility is low. This soil releases moisture readily to plants.

Most of the acreage of this soil is in native grass and is used for grazing or mowed for hay. A few small areas are cultivated, but this soil is generally not suited to cropland because the hazard of erosion is very severe. In some areas, dams are constructed to hold water for livestock and wildlife.

This soil is suited to rangeland, and using it for range is an effective way to control erosion on these steep slopes. Soil erosion is the main hazard. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range condition.

Most areas of this soil are too steep and erodible for planting trees or shrubs in windbreaks. In some areas, trees can be planted by hand for use as wildlife habitat.

This soil is generally not suited to septic tank absorption fields because of the steep slope. A suitable alternate site is needed. Dwellings need to be properly designed to accommodate the slope, or the soil can be graded. Cuts and fills are generally needed to provide a suitable grade for roads. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material helps to ensure better performance.

This soil is assigned to capability unit VIe-9, dryland, the Limy Upland range site, and windbreak suitability group 10.

CrG—Crofton silt loam, 30 to 60 percent slopes. This deep, very steep, excessively drained soil is on side slopes of the uplands. This soil formed in loess. Short, nearly vertical slopes or catsteps are common. Large gullies and entrenched intermittent drainageways are characteristic of the landscape. Individual areas of this soil range from 10 to 50 acres in size.

Typically, the surface layer is brown, very friable silt loam about 4 inches thick. The next layer is brown, very friable silt loam about 3 inches thick. The underlying material is silt loam. It is pale brown in the upper part and light gray in the lower part to a depth of more than 60 inches. Free carbonates are in all parts of the profile. Some small areas have slopes of 15 to 30 percent.

Included with this soil in mapping are small areas of the sandy Thurman and Valentine soils on similar landscapes. Other small areas are glacial till. The included soils make up 15 to 40 percent of this map unit.

Permeability is moderate, and available water capacity is high. Runoff is very rapid. Organic matter content is moderately low, and natural fertility is low. This soil releases moisture readily to plants.

Nearly all the acreage of this soil is in native grass and scattered trees and brush and is used mainly for grazing. In some areas, dams are constructed to hold water for wildlife habitat and livestock.

This soil is not suited to cultivated crops or to introduced grasses because of the very steep slopes.

This soil is suited to rangeland, and this is the best agricultural use of this soil. Using the soil for range is the most effective way to control erosion on these very steep slopes. Overgrazing, however, reduces the protective plant cover and causes deterioration of the native plants. It can also cause severe gully erosion. Proper grazing use, timely deferment of grazing, and a planned grazing system help to maintain or improve the range condition. Brush management may be needed to control undesirable woody plants on the steeper slopes.

This soil is not suited to plantings of trees and shrubs in windbreaks because of the very steep slopes and very severe hazard of erosion. In some areas, trees can be planted by hand for use as a wildlife habitat.

This soil is not suited to sanitary facilities and building sites because of the very steep slopes. A suitable alternate site is needed. Cuts and fills are needed to provide a suitable grade for roads. Roads need to be designed so that the surface pavement and base are thick enough to compensate for low strength of the soil material. Using coarse grained material for subgrade or base material helps to ensure better performance.

This soil is assigned to capability unit VIIe-9, the Thin Loess range site, and windbreak suitability group 10.

CuE2—Crofton-Nora complex, 11 to 15 percent slopes, eroded. This map unit consists of deep, well drained, moderately steep soils on ridges and side slopes of uplands. These soils formed in calcareous

loess. Small gullies and rills are common after heavy rains. Individual areas of this unit range from 5 acres to several hundred acres in size. Individual areas are 50 to 70 percent Crofton soils and 25 to 45 percent Nora soils. Crofton soils are on the narrow ridgetops and upper side slopes. Nora soils are on the lower side slopes. The individual areas of these soils are so intricately mixed or so small that it is not practical to separate them at the scale used in mapping. In many places, the underlying material is at the surface. Erosion has not been uniform.

Typically, the Crofton soils have a surface layer of brown, very friable silt loam about 5 inches thick. Lime concretions are at or near the surface and the soil is calcareous throughout. The underlying material is silt loam. It is pale brown in the upper part and very pale brown in the lower part to a depth of more than 60 inches. In some small areas, where less erosion has occurred, the surface layer is grayish brown or dark brown.

Typically, the Nora soils have a grayish brown, very friable silty clay loam surface layer about 5 inches thick. Erosion has removed most of the original surface layer. The subsoil is friable and about 19 inches thick. It is brown silty clay loam in the upper part and pale brown silt loam in the lower part. Depth to lime is about 12 inches. The underlying material is calcareous silt loam. It is light yellowish brown in the upper part and very pale brown in the lower part to a depth of more than 60 inches. In some small areas, the surface layer is thicker than 7 inches, and in a few small areas, lime is deeper than 30 inches. In other small areas, the surface layer is silt loam.

Included with this complex in mapping are small areas of Alcester and Hobbs soils. The Alcester soils are on the foot slopes below the Crofton and Nora soils. The occasionally flooded Hobbs soils are on the drainageways below the Crofton and Nora soils. The included soils make up 5 to 15 percent of this map unit.

Permeability is moderate, and available water capacity is high in both the Crofton and Nora soils. Runoff is very rapid. Organic matter content is low in the Crofton soils and moderately low in the Nora soils. Natural fertility is medium in the Nora soils and low in the Crofton soils. The surface layer of the Crofton soils is very friable and easily tilled throughout a fairly wide range of moisture conditions. In the Nora soils, good tillage is possible only within a limited range in soil moisture content. Both soils release moisture readily to plants. Both soils are commonly low in available phosphorus. The Crofton soil normally shows a response to the addition of zinc.

Most of the acreage of this unit is farmed, but some areas are in native grass or seeded to introduced grass used for grazing or mowed for hay.

Under dryland farming, the soils are poorly suited to farming because of the moderately steep slopes and the severe hazard of erosion. They are better suited to close-grown crops, such as alfalfa and oats, than to row crops, such as corn. Erosion is difficult to control where row crops are grown. Terraces, waterways, and farming on the contour help slow runoff and control erosion. In a good cropping sequence, row crops are grown infrequently. Grasses and legumes are grown during most years. Conservation tillage practices, such as discing and chiseling, keep crop residue on the soil. Adding nitrogen and phosphorus as commercial fertilizer or in feedlot manure helps to improve and maintain soil fertility.

These soils are not suited to irrigation because of the moderately steep slope and the high risk of erosion.

Use of these soils for pasture is an effective way to control erosion. They are suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa, as well as to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Overgrazing causes deterioration of the desired grasses. Proper degree of use and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer can increase the vigor and growth of grasses.

These soils are suited to native grasses in rangeland, and using these soils for range is an effective way to control erosion. Overgrazing reduces the protective plant cover and can result in severe soil losses by water erosion. Proper grazing use and timely deferment of grazing or haying help to keep the range in good condition. Range seeding may be needed for severely eroded cropland to control erosion.

Crofton soils are fairly suited to trees and shrubs in windbreaks. Competition for moisture from weeds and grasses, calcareous soil, and water erosion are the main management concerns. Cultivation between the tree rows and careful use of appropriate herbicides within rows help to control undesirable weeds and grasses. Only species that tolerate calcareous soil should be planted. Trees can be planted on the contour with terraces to control erosion and runoff.

Nora soils are fairly well suited to trees and shrubs in windbreaks. Water erosion, drought, and moisture competition from weeds and grasses are concerns of management. Trees can be planted on a terraced contour to help control erosion and runoff. Cultivation between the tree rows and careful use of appropriate herbicides within the rows help to control undesirable weeds and grasses.

Land shaping and installing the distribution lines on the contour are needed to assure proper operation of septic tank absorption fields on these soils. Dwellings should be designed to accommodate the slope, or the soils can be graded. Foundations for buildings need to be strengthened and backfilled with coarse material to prevent damage by shrinking and swelling of these soils. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse

Figure 7.—Native hay is an excellent use for this Elsmere loamy fine sand, 0 to 2 percent slopes.

grained material for subgrade or base material helps to ensure better performance. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage and reduce damage by frost action.

This map unit is assigned to capability unit IVe-8, dryland. The Crofton soil is in the Limy Upland range site, and the Nora soil is in the Silty range site. The Crofton soil is in windbreak suitability group 8, and the Nora soil is in windbreak suitability group 3.

Eh—Elsmere loamy fine sand, 0 to 2 percent slopes. This deep, somewhat poorly drained, nearly level soil is on bottom lands and low stream terraces of the Elkhorn River Valley and in swales in areas of the sandhills. This soil formed in eolian sand. This soil is rarely flooded. Individual areas range from 5 to 225 acres in size.

Typically, the surface layer is grayish brown, very friable loamy fine sand about 8 inches thick. The subsurface layer is dark gray, very friable loamy fine sand about 8 inches thick. Beneath this is a layer of grayish brown, loose fine sand about 7 inches thick. The underlying material is light brownish gray fine sand in the upper part and light gray fine sand in the lower part to a depth of more than 60 inches. In a few small areas, the dark surface soil is more than 20 inches thick.

Included in mapping are small areas of Lawet, Libory, Loup, Ovina, and Thurman soils. The poorly drained Lawet and Loup soils are slightly lower on the landscape than this Elsmere soil. Libory soils are moderately well drained and are higher on the landscape. Ovina soils have less sand in the lower part of the profile and are on the same landscape. Thurman soils are somewhat excessively drained and higher on the landscape. The included soils make up about 10 to 15 percent of this unit.

Permeability of this Elsmere soil is rapid, and the available water capacity is low. Depth to the seasonal high water table ranges from 1.5 feet in most wet years to 2.5 feet in most dry years. Runoff is slow. Organic matter content is moderately low, and natural fertility is low. The rate of water intake is very high. This soil releases moisture readily to plants.

Some of the acreage of this soil is cultivated, but many areas are in native grass and are used for grazing or mowed for hay (fig. 7).

Under dryland farming, this soil is suited to corn and grain sorghum. It is not as well suited to alfalfa because of soil wetness. The main limitation of this soil to growing crops is the seasonal high water table, which delays tillage and causes the soil to warm slowly in the spring. Soil blowing is a hazard if the vegetative cover is

removed. Conservation tillage practices, such as chiseling, discing, or no-till planting, leave crop residue on the surface and thereby help to prevent soil blowing. Planting narrow field windbreaks also helps to prevent soil blowing. Returning crop residue to the soil helps conserve soil moisture. Applying feedlot manure helps maintain organic matter content and improve the soil's fertility.

If irrigated, this soil is suited to the sprinkler system of irrigation. Corn and grain sorghum are the main crops grown. Alfalfa can be grown, but it is generally short-lived. Frequent applications of water are needed because of this soil's very high rate of water intake and its low water-holding capacity. The amount of water applied should be limited to avoid causing leaching of plant nutrients below the root zone. This soil is not suited to gravity systems because of the very high rate of water intake. Conservation tillage practices, such as chiseling or using a no-till planting system, leave crop residue on the surface and thereby help to prevent soil blowing. Planting cover crops also helps to prevent soil blowing. Drainage ditches can be contructed to help lower the seasonal high water table.

This soil is suited to introduced grasses that tolerate a high water table, such as reed canarygrass and creeping foxtail. The use of this soil for either pasture or hay effectively controls soil blowing. Alternate pastures, one of cool-season grasses and one of warm-season grasses, can be used for a long grazing season. Overgrazing reduces the protective vegetative cover, allowing weeds to grow and soil blowing to occur. Proper stocking, rotational grazing, and weed control help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water helps increase the vigor and growth of grasses.

This soil is suited to rangeland. Using it for range is a very effective way to control soil blowing. Overgrazing, untimely haying, and use of improper mowing heights reduce the vegetative cover and cause deterioration of the desired grasses. Proper grazing use, timely deferment of grazing or haying, and restricting use during very wet periods help maintain the native grasses in good condition.

If this soil is used for windbreaks, it is suited to trees and shrubs that can tolerate wetness from the seasonal high water table. In some years, wetness makes it difficult to establish seedlings. Maintaining cover crops between the rows helps to control soil blowing. Moisture competition from grass and weeds is a common problem. Weeds can be controlled by careful application of approriate herbicides and by hand hoeing or roto-tilling within the rows.

This soil generally is not suited to septic tank absorption fields because of wetness caused by the seasonal high water table. An alternate site is needed. The walls or sides of shallow excavations should be temporarily shored to prevent sloughing or caving. Dwellings need to be constructed on elevated, well compacted fill material to overcome wetness caused by the seasonal high water table and flooding. Constructing roads on suitable, compacted fill material above the flood level and providing adequate side ditches and culverts help to protect the roads from flood damage and wetness. Damage to roads by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIIw-5, dryland, and IIIw-11, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

Ek—Elsmere fine sandy loam, 0 to 1 percent slopes. This deep, somewhat poorly drained, nearly level soil is on bottom lands, low stream terraces, and depressional valleys of the sandhills. It is subject to rare flooding. This soil formed in eolian sand. Individual areas range from 5 to 160 acres in size.

Typically, the surface layer is very friable fine sandy loam about 13 inches thick. It is very dark gray in the upper part and dark gray in the lower part. The next layer, a transition layer, is dark grayish brown, loose loamy fine sand about 4 inches thick. The underlying material is fine sand. It is light brownish gray in the upper part and light gray in the lower part to a depth of more than 60 inches. Some small areas have a surface layer of loam. Other small areas have a dark surface layer 20 to 26 inches thick.

Included with this soil in mapping are small areas of Loup and Thurman soils. Loup soils are poorly drained and are slightly lower on the landscape than the Elsmere soil. Thurman soils are somewhat excessively drained and are higher on the landscape. The included soils make up 3 to 10 percent of this map unit.

Permeability is rapid in this Elsmere soil, and the available water capacity is low. This soil has a seasonal high water table that ranges from 1.5 feet below the surface in most wet years to a depth of about 2.5 feet in most dry years. The rate of water intake is moderately high. Organic matter content is moderately low, and natural fertility is low. Runoff is slow. This soil releases moisture readily to plants.

Most of the acreage of this soil is in native grasses and is mowed for hay. A few areas are tilled and are used for cultivated crops or for pasture.

If cultivated, this soil is suited to corn and grain sorghum. This soil is not well suited to alfalfa because of soil wetness. The high water table often delays tillage in the spring. Soil blowing is a hazard if the vegetative cover is removed. Conservation tillage practices, such as discing or using a no-till system, help to prevent soil blowing. Planting narrow field windbreaks also helps to prevent soil blowing. Returning crop residue to the soil

helps to conserve soil moisture. Applying feedlot manure helps to maintain organic matter content and fertility.

If irrigated, this soil is suited to only the sprinkler system of irrigation. Corn and grain sorghum are the main crops grown. It is not suited to gravity irrigation because of its sandy texture. Frequent applications of water are needed because of the rapid permeability and low available water capacity of the soil, but the amount of water applied should be limited to prevent leaching of plant nutrients below the root zone. Conservation tillage practices, such as chiseling or using a no-till planting system, leave crop residue on the surface and thereby help to prevent soil blowing. Planting cover crops also helps to prevent soil blowing. Drainage ditches can be constructed to help lower the water table.

This soil is suited to introduced grasses that tolerate a high water table, such as reed canarygrass and creeping foxtail. The use of this soil for either pasture or hay effectively controls soil blowing. The soil is suited to both cool-season and warm-season grasses. Alternate pastures, one of cool-season grass and one of warm-season grass, can be used for a long grazing season. Overgrazing reduces the protective vegetative cover and allows weeds to grow. Proper stocking, rotational grazing, and weed control help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water helps to increase the vigor and growth of grasses.

This soil is suited to rangeland, and using it for range is very effective in controlling soil blowing. Overgrazing, untimely haying, and use of improper mowing heights reduce the plant cover and cause deterioration of the desired grasses. Proper grazing use, timely deferment of grazing or haying, and restricting use during very wet periods help maintain the native grasses in good condition.

If used for windbreaks, this soil is suited to trees and shrubs that can tolerate wetness from the seasonal high water table. In some years, wetness makes establishing seedlings difficult. Maintaining cover crops between the rows helps to control soil blowing. Moisture competition from grass and weeds is a common limitation. Weeds can be controlled by careful application of appropriate herbicides or by roto-tilling within the rows.

This soil generally is not suited to septic tank absorption fields because of wetness caused by the seasonal high water table. An alternate site is needed. The walls or sides of shallow excavations should be temporarily shored to prevent sloughing or caving. Dwellings need to be constructed on elevated, well compacted fill material to overcome wetness caused by the seasonal high water table and flooding. Constructing roads on suitable, compacted fill material above flood level and providing adequate side ditches and culverts help protect roads from flood damage and wetness. Damage to roads by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIIw-5, dryland, and IIIw-11, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

Fm—Fillmore silt loam, 0 to 1 percent slopes. This deep, nearly level, poorly drained soil is in depressions of the uplands and stream terraces. This soil formed in loess. It is occasionally ponded. Individual areas range from 3 to 10 acres in size.

Typically, the surface layer is gray, very friable silt loam about 8 inches thick. Beneath this is a subsurface layer of gray, very friable silt loam about 7 inches thick. The firm silty clay subsoil is about 37 inches thick. The upper and middle parts are dark gray, and the lower part is gray. The underlying material is light brownish gray, mottled silty clay loam to a depth of more than 60 inches. In a few small areas, the gray subsurface layer is absent.

Included with this soil in mapping are small areas of the well drained Belfore and Moody soils. They are higher on the landscape than the Fillmore soil. The included soils make up about 5 to 15 percent of this map unit.

This Fillmore soil has very slow permeability, high available water capacity, and a low rate of water intake. Runoff is ponded. Organic matter content is moderate, and natural fertility is medium. A perched seasonal high water table is near or above the surface in most wet years. The surface layer is easily tilled when dry or moist, but it is difficult to till when wet. Shrink-swell potential is high.

Most of the acreage of this soil is cultivated, but a few areas are in grass and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, grain sorghum, and soybeans. Wetness and runoff water from adjacent higher soils are the main limitations. If suitable outlets are available, drainage can be used to overcome wetness. Drainage is generally necessary for alfalfa production. Conservation tillage practices, such as discing, chiseling, or no-till planting, keep crop residue on the surface. Liming the soil periodically may be necessary under continuous cropping. Returning crop residue to the soil and applying feedlot manure help to maintain organic matter content and improve fertility. This soil is somewhat droughty during dry years because the subsoil absorbs moisture slowly and releases it slowly to plants.

This soil is poorly suited to both gravity and sprinkler irrigation. If irrigated, this soil is suited to corn, grain sorghum, and soybeans. Wetness and runoff of water from adjacent higher soils are the main limitations. A low rate of water intake is also a limitation. Land leveling is needed for gravity irrigation. Land leveling helps to improve surface drainage and increases the efficiency of

irrigation systems. If a suitable outlet is available, drainage can be used to overcome wetness. Liming the soil periodically may be necessary under continuous cropping. Returning crop residue to the soil and applying feedlot manure help to maintain organic matter content and improve fertility.

If used for pasture, this soil is generally suited to cool-season grasses, such as reed canarygrass or creeping foxtail, as well as to warm-season grasses. Grasses may be difficult to establish if runoff from adjacent soils is not controlled. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Pastures can be used in rotation with row crops. Overgrazing, grazing when the soil is wet, and haying by improper methods reduce the protective plant cover and cause deterioration of desired grasses. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and water can increase the growth and vigor of introduced grasses.

This soil is suited to rangeland. Overgrazing by livestock and deposition of silt by runoff water cause deterioration of desired native grasses. Proper grazing use, a planned grazing system, and timely deferment of grazing or haying help to maintain or improve range condition.

This soil generally is poorly suited to planting seedlings. Only those trees that tolerate wetness and ponding of surface water can be grown on this soil. Establishing trees can be difficult in wet years.

This Fillmore soil is not suited to septic tank absorption fields because of ponding and very slow permeability. A suitable alternate site is needed. This soil is not suited to building sites because of ponding and shrink-swell potential. Constructing roads on suitable fill material and providing adequate ditches and culverts help protect roads from ponding. Roads need to be designed so that the surface pavement is thick enough to compensate for the low strength of the soil. Establishing a gravel moisture barrier in the subgrade and providing adequate surface drainage can help to prevent damage by frost action.

This soil is assigned to capability units IIIw-2, dryland, and IIIw-2, irrigated, the Clayey Overflow range site, and windbreak suitability group 2W.

Gk—Gibbon silty clay loam, 0 to 1 percent slopes. This deep, somewhat poorly drained, nearly level soil is on bottom lands of the Elkhorn River Valley. It formed in calcareous alluvium. This soil is subject to occasional flooding. Individual areas range from 5 acres to several hundred acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 10 inches thick. The subsurface layer is gray, very friable silty clay loam about 9 inches thick. The underlying material is light gray silt loam in the upper part and gray fine sandy loam in the lower part to a depth of more than 60 inches. Depth to lime ranges from 0 to 10 inches. Some areas have a dark surface layer 20 to 30 inches thick. In other small areas, the soil material is silt loam to a depth of more than 60 inches.

Included with this soil in mapping are small areas of Boel, Cass, and Ord soils. Boel soils have fine sand higher in the profile and are lower on the landscape than the Gibbon soil. The well drained Cass soils are slightly higher on the landscape. Ord soils have fine sand higher in the profile and are on similar landscapes. The included soils make up 10 to 15 percent of this map unit.

Permeability of this Gibbon soil is moderate, and the available water capacity is high. Runoff is slow. The seasonal high water table is at a depth of about 1.5 feet in most wet years and about 3 feet in most dry years. The water table is generally highest in spring. The organic matter content is moderate, and natural fertility is high. Intake rate of water is low. Tilth is fair. Good tillage is possible only within a limited range of soil moisture content. This soil releases moisture readily to plants.

Most of the acreage of this soil is used for cultivated crops, and the rest is mainly in native grass. Some small areas are irrigated.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, and alfalfa. It is not as well suited to spring-sown small grains because wetness in early spring delays planting. In wet years, the high water table limits production of alfalfa. If suitable outlets are available, tile drains help to lower the seasonal water table and to control wetness. Conservation tillage practices, such as no-till planting, keep crop residue on the surface and help to prevent evaporation of moisture.

If irrigated, this soil is suited to gravity or sprinkler systems. Corn, soybeans, and alfalfa are the main crops grown under irrigation. The principal limitation is soil wetness. If suitable outlets are available, tile drains can be installed to help lower the seasonal high water table. Land leveling may be needed for gravity irrigation. Diversion terraces can be used to lessen the damage from flooding. Keeping crop residue on the surface and applying feedlot manure help to maintain or improve fertility and slow the evaporation of soil moisture. Conservation tillage practices, such as chiseling, discing, or no-till planting, are effective on this soil.

This soil is suited to introduced grasses, such as reed canarygrass or creeping foxtail, mixed with alfalfa. Alternate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Pasture grasses can be used in rotation with row crops. Overgrazing causes deterioration of the desired grasses. Grazing when the soil is wet can cause soil compaction, making grazing or haying more difficult. Proper stocking and rotational grazing help to maintain the desired grasses. Adding nitrogen fertilizer and irrigation water improve the growth and vigor of grasses.

This soil is suited to native grasses for rangeland, either for grazing or haying. Overgrazing, untimely haying, and use of improper mowing heights reduce the

protective plant cover and cause deterioration of the native plants. In addition, overgrazing when the soil is wet causes surface compaction, making grazing or haying difficult. Proper grazing use, timely deferment of grazing or haying, and restriction on use during wet periods help to maintain the desired grasses and keep the soil in good condition.

This Gibbon soil is suited to trees and shrubs in windbreaks. It is best suited to those species that tolerate a seasonal high water table and occasional flooding. Establishing seedlings can be difficult in wet years. Undesirable grasses and weeds are a concern in windbreaks. Cultivation between tree rows and careful use of appropriate herbicides within the rows can control weeds. Areas near the trees can be roto-tilled.

This soil is not suited to septic tank absorption fields or to use as building sites because of wetness and flooding. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help protect roads from flood damage. Damage to roads by frost action can be reduced by providing good surface drainage and by establishing a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide surface drainage.

This soil is assigned to capability units IIw-4, dryland, and IIw-3, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

Gs—Gibbon-Gayville silty clay loams, 0 to 1 percent slopes. This map unit consists of deep, somewhat poorly drained, nearly level soils on bottom lands. The Gibbon soil formed in silty, calcareous alluvium. The Gayville soil formed in silty and loamy alluvium that is high in exchangeable sodium. The soils in this unit are occasionally flooded. Individual areas of this complex range from 5 acres to several hundred acres in size. About 60 to 70 percent of this map unit is Gibbon soil and about 30 to 40 percent is Gayville soil. The two soils are so intricately mixed that it is not practical to separate them at the scale used in mapping.

Typically, the surface soil of the Gibbon soil is dark gray, very friable, calcareous silty clay loam about 15 inches thick. The next layer is light brownish gray, very friable silty clay loam about 5 inches thick. The underlying material is light grayish brown, calcareous silt loam in the upper part; dark gray, stratified silty clay loam and silt loam in the middle part; and light gray silt loam in the lower part to a depth of more than 60 inches. In a few small areas, depth to lime is more than 10 inches. In some other small areas, the surface layer is silt loam. In some small areas, layers of fine sandy loam and loamy fine sand are below a depth of 40 inches.

Typically, the Gayville soil has a surface layer of gray, very friable silty clay loam about 1 inch thick. The subsoil is about 28 inches thick. It is dark gray, firm silty clay loam in the upper part; dark gray, firm clay loam in the middle part; and grayish brown, firm clay loam in the lower part. The underlying material is gray silt loam in the upper part and gray silty clay loam in the lower part to a depth of more than 60 inches. In a few small areas, the surface layer is silt loam. In other small areas, fine sand layers are below a depth of 40 inches. This Gayville soil is high in alkalinity.

Included with this complex in mapping are small areas of Cass and Ord soils. The well drained Cass soils are higher on the landscape than the Gibbon and Gayville soils. Ord soils are on similar landscapes. The included soils make up about 10 to 15 percent of this map unit.

Permeability is moderate in the Gibbon soil and very slow in the Gayville soil. The rate of water intake is low in both soils, and the available water capacity is high in the Gibbon soil and moderate in the Gayville soil. Organic matter content is moderate in both soils. Natural fertility is high in the Gibbon soil and low in the Gayville soil. The Gibbon soil has a seasonal high water table that fluctuates from a depth of 1.5 feet in most wet years to about 3 feet in most dry years. The Gayville soil has a seasonal high water table that fluctuates from a depth of 2 feet in most wet years to about 3 feet in most dry years. On the Gibbon soil, good tillage is possible only within a limited range in soil moisture content. The Gayville soil is sticky and difficult to work when wet and hard and cloddy when dry. Puddling is common because of the high content of sodium. The Gibbon soil releases water readily to plants, but in the Gayville soil alkalinity lowers the ability of crop roots to absorb water.

Most of the areas of this complex are cultivated, but some areas are in grass and are used for grazing or mowed for hay. Some areas are in trees and shrubs and are used for windbreaks or wildlife areas. Some of the cultivated areas are irrigated.

Under dryland farming, the soils in this complex are poorly suited to corn, soybeans, and alfalfa because of the accumulation of excess salts, poor soil structure, and ponding of water in low areas. These soils are better suited to small grains and grain sorghum. Surface drainage is needed on these soils. The small depressions can be filled by land leveling. If suitable outlets are available, the high water table can be lowered by tile or V-shaped drainage ditches. On the Gayville soil, chemical amendments can be used to neutralize the salinity and alkalinity. Returning crop residues to the surface, keeping tillage to a minimum, and applying chemical amendments and feedlot manure help to improve tilth and fertility on both the Gibbon and the Gayville soils.

This complex is poorly suited to irrigated crops because of wetness and the high alkalinity and salinity of the Gayville soil. Both gravity and sprinkler irrigation systems can be used. These soils are best suited to alkali-tolerant crops, but corn, grain sorghum, soybeans,

and alfalfa can be grown. Land leveling improves surface drainage and can improve some of the alkali areas by covering them with better soil. Returning crop residue to the surface, keeping tillage to a minimum, and applying chemical amendments and feedlot manure to the high alkali areas help to improve tilth and fertility.

These soils are suited to introduced pasture. If these soils are used for pasture, they are generally suited to alkali-tolerant grasses, such as tall wheatgrass, mixed with a legume. Warm-season grasses can be used for a long grazing season. Pasture can be used in rotation with cultivated crops. Overgrazing, grazing when the soil is wet, or using improper haying methods reduce the protective plant cover and cause deterioration of desired grasses. Also, grazing when this soil is wet can cause surface compaction and small mounds, making harvesting or grazing difficult. Proper stocking rate and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and water can increase vigor and growth of grasses.

These Gibbon and Gayville soils are suited to rangeland. They are suited to either grazing or haying. Overgrazing or improper haying methods reduce the protective plant cover and cause deterioration of desired grasses. When the soil is wet, overgrazing can cause surface compaction and small mounds, making grazing or haying difficult. Proper grazing use and timely deferment of grazing keep the grasses in good condition.

This complex is poorly suited to trees and shrubs in windbreaks. Establishing seedlings during wet years and high alkalinity are the main limitations. Wetness can be overcome by using tile drainage to lower the water table if a suitable drainage outlet can be found or by delaying planting of seedlings until soil is sufficiently dry. Only those species that tolerate high alkalinity can survive on these soils. Undesirable weeds and grasses can be controlled by cultivation between the rows or by careful use of appropriate herbicides.

These soils are not suited to septic tank absorption fields and to buildings and dwellings because of flooding and wetness. Slow percolation is also a limitation to the use of these soils for septic tank absorption fields. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help protect roads from flood damage and wetness. Using a gravel moisture barrier in the subgrade or base helps to reduce damage by frost action.

This map unit is assigned to capability units IVs-1, dryland, and IIIs-3, irrigated; the Subirrigated range site for the Gibbon soil and the Saline Subirrigated range site for the Gayville soil; and to windbreak suitability group 2S for the Gibbon soil and 9S for the Gayville soil.

HaC—Hadar loamy fine sand, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on ridges and side slopes of the uplands. This soil formed in eolian sand over glacial till. Individual areas of this soil range from 3 to 250 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 4 inches thick. The subsurface layer is also dark grayish brown, very friable loamy fine sand about 10 inches thick. Below this is a layer of brown, very friable loamy fine sand about 10 inches thick. The subsoil is light yellowish brown, mottled, firm clay loam about 12 inches thick. The underlying material to a depth of more than 60 inches is clay loam. It is light gray and mottled in the upper part, and it is gray and mottled in the lower part. In a few small areas, the loamy fine sand surface layer is 6 to 12 inches thick, and in some small areas, the surface soil is fine sandy loam. In cultivated areas, the plow layer is commonly lighter in color than is typical, and it is fine sand because of winnowing. In a few small areas the subsoil is reddish brown.

Included with this soil in mapping are small areas of Clarno and Thurman soils. The Clarno soil has less sand in the surface layer and is slightly lower on the landscape than the Hadar soil. The Thurman soil is somewhat excessively drained and is higher on the landscape. The included soils make up about 5 to 20 percent of each mapped area.

Permeability is rapid in the upper, sandy part of this Hadar soil and moderately slow in the lower clay loam glacial material. The available water capacity is moderate, and the rate of water intake is high. Runoff is slow. The organic matter content is moderately low, and natural fertility is medium. The surface layer is easily tilled throughout a wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is cultivated, but a few areas are in native grass and are used for grazing or mowed for hay. Some areas near urban areas are used as sites for buildings.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, oats, and alfalfa. Soil blowing and water erosion are the principal hazards. Conservation tillage practices, such as discing and stubble mulching, keep crop residue on the surface and thereby help to prevent soil blowing. Terraces, grassed waterways, and contour stripcropping help to prevent water erosion. Keeping crop residue on the soil surface also helps to prevent evaporation of soil moisture.

If irrigated, this soil is suited to sprinkler irrigation. This soil is not suited to a gravity system unless the land is extensively prepared. A gravity system can be used if the soil is bench leveled and contour furrows, terraces, and grassed waterways are used. Bench land leveling helps to increase irrigation efficiency. This soil's high rate of water intake limits the amount of water that can be applied.

Corn, soybeans, grain sorghum, and alfalfa can be grown on this Hadar soil. Soil blowing and water erosion are the principal hazards to use of this soil as cropland.

Maintaining fertility is a management concern. A conservation tillage system, such as discing, chiseling, or no-till planting for row crops, keeps most or all of the crop residue on the surface and thereby helps to control soil blowing and reduce water erosion. Applying feedlot manure helps to maintain fertility and improve soil tilth.

This soil is suited to introduced grass pasture. Using this soil for pasture is an effective way to control soil blowing. The soil is generally suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa. Warm-season grasses can be used for a long grazing season. Pasture can also be used in a cropping sequence with row crops. Overgrazing reduces the protective plant cover and causes deterioration of the desired grasses. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water can increase the vigor and growth of grasses.

This soil is suited to native grass in rangeland and can be used for grazing or mowed for hay. Using this soil for range is an effective way to control soil blowing. Overgrazing, untimely haying, and use of improper mowing heights reduce the protective plant cover and cause deterioration of the desired grasses. Reducing protective cover can cause severe losses by soil blowing or water erosion. A planned grazing system, proper grazing use, and timely deferment of grazing help to maintain or improve the range condition.

This soil generally is fairly suited to trees and shrubs in windbreaks. Inadequate moisture limits growth of trees and shrubs. Planting a cover crop between the rows helps to prevent soil blowing, which is the main hazard on this soil. Undesirable grasses and weeds can be controlled by cultivation between the trees and by careful use of appropriate herbicides in the tree row. Supplemental watering can provide needed moisture during dry periods.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this limitation can generally be overcome by increasing the size of the absorption field. Foundations for buildings need to be strengthened and backfilled with coarse materials to prevent damage by shrinking and swelling of the soil. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance. Mixing the base material with additives, such as hydrated lime, helps prevent damage caused by shrinking and swelling of the soil.

This soil is assigned to capability units IIIe-6, dryland, and IIIe-10, irrigated, the Sandy range site, and windbreak suitability group 5.

Hd—Hobbs silt loam, 0 to 2 percent slopes. This deep, well drained, nearly level soil is on bottom lands in narrow drainageways of uplands. This soil formed in stratified, noncalcareous silty alluvium. It is occasionally flooded. Areas of this soil are long and narrow and range from 5 acres to several hundred acres in size.

Typically, the surface layer is grayish brown, very friable silt loam about 8 inches thick. The underlying material is silt loam about 32 inches thick. The upper part is stratified grayish brown and light brownish gray, and the lower part is stratified brown and pale brown. Below this is a buried soil of dark grayish brown silt loam to a depth of more than 60 inches. In a few small areas, the soil contains lime at or near the surface because of recent deposition. In a few areas, the soil is dark grayish brown above a depth of 40 inches.

Included with this soil in mapping are small areas of Alcester, Colo, Muir, and Shell soils. Alcester soils are not flooded and are on foot slopes higher on the landscape than the Hobbs soil. Colo soils are somewhat poorly drained and are on the same landscape. Muir soils are not stratified and are on stream terraces higher on the landscape. Shell soils are stratified lower in the profile and are on similar landscapes. The included soils make up about 5 to 15 percent of this map unit.

Permeability is moderate in this Hobbs soil, and the available water capacity is high. Runoff is medium. Organic matter content is moderate, and natural fertility is medium. The water intake rate is moderate. The Hobbs soil is commonly flooded, but the floodwater normally recedes after a brief time. The surface layer is easily tilled throughout a fairly wide range of moisture conditions. This soil releases water readily to plants.

Most of the acreage of this soil is in cultivated crops, but a few areas are in introduced grasses and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, grain sorghum, oats, soybeans, and alfalfa. Flooding can delay tillage and limit production of small grains and alfalfa. Siltation after flooding can limit production of row crops. Diversions and drainage ditches can be used to intercept runoff and thereby to keep the water from spreading. Conservation tillage practices, such as no-till planting and discing, keep crop residue on the surface, thereby reducing evaporation of soil moisture and maintaining and improving the organic matter content.

If irrigated, this soil is suited to both gravity and sprinkler systems, but flooding needs to be controlled. The soil is suited to corn, grain sorghum, soybeans, and alfalfa. For gravity irrigation, land preparation is needed to divert and intercept the floodwaters. Sprinkler irrigation works well on this soil. Controlling runoff from the adjoining uplands by use of a diversion terrace reduces flooding. Conservation tillage practices, such as chiseling, no-till planting, and discing, keep crop residue on the surface and effectively prevent evaporation of soil moisture.

This soil is suited to introduced grass pasture. Cool-season grasses, such as smooth brome, orchardgrass,

or tall fescue, can be mixed with alfalfa. Warm-season grasses can also be grown. Siltation from flooding can prevent establishment of newly planted grasses and alfalfa. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Pasture grasses can also be used in rotation with cultivated crops. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water can increase the vigor and growth of grasses.

This soil is suited to rangeland and native hay. Overgrazing by livestock and haying at improper times or by improper methods reduce the protective cover and cause deterioration of desired grasses. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil is generally well suited to trees and shrubs in windbreaks. This soil is best suited to trees and shrubs that can tolerate occasional flooding. Competition for moisture from weeds and grasses is the main concern of management. Undesirable weeds and grasses can be controlled by cultivation between the rows and by careful use of appropriate herbicides or roto-tilling within the rows.

This soil is not suited to septic tank absorption fields or construction of buildings because of flooding. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect roads from flood damage. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance.

This soil is assigned to capability units IIw-3, dryland, and IIw-6, irrigated, the Silty Overflow range site, and windbreak suitability group 1.

He—Hobbs silt loam, channeled. This deep soil is channeled and occurs on bottom lands of perennial and intermittent drainageways. It formed in stratified, noncalcareous silty alluvium. Many areas include short streambanks or breaks to the bottoms of the meandering channels. This soil is frequently flooded. Individual areas of this soil range from 20 to 200 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 8 inches thick. The underlying material is brown, pale brown, and dark grayish brown, stratified silt loam to a depth of more than 60 inches. In a few small areas, the texture of the surface layer is silty clay loam. Some small areas are occasionally flooded, and some areas do not have channels.

Included with this soil in mapping are small areas of Shell soils. Shell soils are not stratified in the upper part of the profile. Shell soils are occasionally flooded and are slightly higher on the landscape than the Hobbs soil. The included soils make up about 5 to 15 percent of this map unit.

Permeability is moderate in this Hobbs soil, and the available water capacity is high. Runoff is slow. Organic matter content is moderate, and natural fertility is medium. The surface layer is very friable. This soil releases moisture readily to plants.

Most of the acreage of this soil is in native grasses and trees and is used for grazing. This soil is not suited to cultivation or to irrigation because it is frequently flooded and channeled. This soil is best suited to native grass for grazing. A few small areas that can be tilled are suited to introduced grasses. The principal limitation of this soil is inaccessibility of some areas to livestock because of steep channels. Flooding is the main hazard on this soil.

This soil is well suited to use as rangeland, and this use helps to control cutbank erosion. Overgrazing and silt deposition reduce the protective plant cover and cause deterioration of the desired grasses. Grazing when the soil is wet can cause compaction. This reduces the rate of water intake and growth of the grasses. Proper range use, deferred grazing, and a planned grazing system help to keep the range in good condition. Cut banks can be backsloped to improve access for grazing if the channels are not too deep and the grade is not too steep.

This soil is not suited to trees and shrubs in windbreaks mainly because it is subject to frequent flooding. Some areas can be used for recreation, forestation, and wildlife plantings if trees and shrubs are planted by hand.

This soil is not suited to septic tank absorption fields and dwellings because of frequent flooding. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above the flood level and providing adequate side ditches and culverts or bridges help to protect roads from flood damage. Roads need a surface pavement thick enough to compensate for low strength. Using coarse grained material for the subgrade or base material can ensure better performance.

This soil is assigned to capability unit VIw-7, dryland, the Silty Overflow range site, and windbreak suitability group 10.

InB—Inavale loamy fine sand, 0 to 3 percent slopes. This deep, somewhat excessively drained, nearly level and very gently sloping soil is on low ridges on bottom lands and is occasionally flooded. This soil formed in sandy alluvium. Individual areas of this soil range from 5 to 50 acres in size.

Typically, the surface layer is dark gray, very friable loamy fine sand about 7 inches thick. The next layer is grayish brown, very friable loamy fine sand about 8 inches thick. The underlying material is pale brown fine sand in the upper part, pale brown very fine sandy loam in the middle part, and very pale brown fine sand in the

lower part to a depth of more than 60 inches. In some small areas, the surface layer is fine sand. In other small areas, the surface layer is loam or sandy loam.

Included with this soil in mapping are small areas of Boel, Cass, and Ord soils. Boel and Ord soils are somewhat poorly drained and are slightly lower on the landscape than the Inavale soil. Cass soils are well drained and are slightly higher on the landscape. The included soils make up about 5 to 20 percent of this map unit.

Permeability is rapid in this Inavale soil, and the available water capacity is low. Organic matter content and natural fertility are low. Runoff is slow. The rate of water intake is very high. Workability of this sandy soil is fair. Moisture is released readily to plants.

Most areas of this soil are in cultivated crops, but a few areas are in introduced grasses or in rangeland and are mowed for hay or used for grazing.

Under dryland farming, this soil is poorly suited to most crops. It is best suited to oats, alfalfa, vetch, and rye. Corn and grain sorghum can be grown occasionally if a conservation tillage system that keeps crop residue on the surface is used. Soil blowing is a severe hazard on this soil. Conservation tillage practices that keep crop residue on the surface, such as discing or a no-till planting system, help to prevent soil blowing. Field windbreaks also help to prevent soil blowing.

Under irrigation, corn, grain sorghum, and alfalfa can be grown. This sandy soil is suited to a sprinkler system of irrigation. It is not suited to a gravity system. Light, frequent applications of water are needed because of this soil's rapid permeability and very high rate of water intake. Excess water leaches plant nutrients and herbicides below the depth of plant roots. Soil blowing is a serious hazard if a protective cover is not maintained. Conservation tillage practices that keep crop residue on the surface help to prevent soil blowing. Application of feedlot manure helps to maintain the organic matter content and improve the fertility of the soil.

This soil is suited to introduced grass pasture. It is suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa, as well as to warm-season grasses. Using this soil for pasture is an effective way to control soil blowing. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Introduced grasses can be used as part of a cropping system that includes row crops. Overgrazing can weaken or reduce the protective plant cover, thereby causing deterioration of the desired grasses and increasing the hazard of soil blowing. Proper stocking and rotational grazing help to keep the grasses in good condition. Irrigation and application of nitrogen fertilizer can increase the vigor and growth of grasses.

This soil is suited to native grass and is used for rangeland. Using this soil for range is an effective way to control soil blowing. Overgrazing, untimely haying, and use of improper mowing heights reduce the protective plant cover and cause deterioration of the native plants. These practices also cause severe soil blowing and small blowouts. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil is fairly suited to trees and shrubs in windbreaks. Only those species that can tolerate somewhat droughty soils should be planted. Soil blowing is the main hazard, and competition for moisture from weeds and grasses is the main limitation. Soil blowing can be controlled by maintaining strips of sod or planting a cover crop between the rows. Cultivation needs to be restricted to the tree rows. Weeds and grasses can be controlled by use of appropriate herbicides or by roto-tilling within the tree rows. Irrigation may be needed during periods of inadequate rainfall.

This Inavale soil is not suited to septic tank absorption fields because of flooding and the poor filtering action of the fine sand underlying material. A suitable alternate site is needed. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. This soil is not suited to use as building sites because of the hazard of flooding. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect roads from flood damage.

This soil is assigned to capability units IVe-5, dryland, and IIIe-11, irrigated, the Sandy Lowland range site, and windbreak suitability group 5.

Ip—Inavale-Boel complex, 0 to 6 percent slopes. This complex consists of deep soils on bottom lands of the Elkhorn River Valley. The Inavale soils are somewhat excessively drained, are very gently sloping and gently sloping, and are occasionally flooded. They formed in recent sandy alluvium. The Boel soils are somewhat poorly drained, are nearly level, and are frequently flooded. They formed in sandy alluvium. Individual areas of this complex range from 5 acres to several hundred acres in size. Areas of this complex are 50 to 60 percent Inavale soils and 40 to 50 percent Boel soils. The individual areas of these soils are so intricately mixed that it is not practical to separate them at the scale used in mapping.

Typically, the Inavale soils have a grayish brown, loose, loamy fine sand surface layer about 8 inches thick. The next layer is light brownish gray, loose, fine sand about 4 inches thick. The underlying material is fine sand. It is light gray in the upper part and light brownish gray in the lower part to a depth of more than 60 inches. The underlying material has thin layers of fine sandy loam, loam, and silt loam. Some small areas have a loam or silt loam surface layer. Other small areas have a thicker surface layer.

Typically, the Boel soils have a very dark grayish brown, very friable loam surface layer about 10 inches thick. The next layer is dark grayish brown, friable, fine sandy loam about 4 inches thick. The underlying material is mottled fine sand. It is pale brown in the upper part and light gray in the lower part to a depth of more than 60 inches. Some areas have a fine sandy loam surface layer. Other areas have a silt loam surface layer. In many places, the underlying material has thin layers of loam or fine sandy loam material.

Permeability of both the Boel and Inavale soils is rapid. The available water capacity is low. Organic matter content is low in the Inavale soils and moderately low in the Boel soils. Natural fertility is low in the Inavale soils and medium in the Boel soils. Runoff is slow. Boel soils have a seasonal high water table that fluctuates from a depth of about 1.5 feet in most wet years to a depth of about 3.5 feet in most dry years. The water table is commonly highest in the spring. Soils in this complex release moisture readily to plants.

Included with this complex in mapping are small areas of Cass, Loup, Marlake, and Ord soils and old stream channels. The well drained Cass soils are higher on the landscape. Loup soils are poorly drained and are slightly lower on the landscape than the Inavale and Boel soils. Ord soils are deeper to fine sand and are slightly higher on the landscape. Marlake soils are wetter and lower on the landscape. The channels are few to many and are on the lowest part of the landscape. The inclusions make up 10 to 20 percent of this map unit.

Most of the acreage of this complex is in grass, trees, and shrubs and is used for grazing or wildlife areas. A few small areas are used for cultivated crops. Hunting and fishing are common recreational uses for these areas.

Soils in this complex are not suited to dryland or irrigated cultivated crops because of the flooding and droughtiness.

These soils are poorly suited to introduced grass for pasture because of flooding. Some small, isolated tracts can be used for tame pasture. The Inavale soils are suited to such cool-season grasses as smooth brome, orchardgrass, and sand lovegrass. The Boel soils are suited to such cool-season grasses as reed canarygrass and creeping foxtail. Using these soils for tame pasture is an effective way to control soil blowing. Planting grasses is difficult in some areas. These areas may need to be seeded by hand or by small hand-operated seeders. Introduced grasses can be used in rotation with native grass for effective pasture use. Overgrazing can weaken or reduce protective cover, thereby causing deterioration of desired grasses and increasing the hazard of soil blowing. Proper stocking and rotational grazing help to keep the grasses in good condition.

Soils in this complex are poorly suited to rangeland because of the thick stands of trees and frequent flooding. Small, isolated tracts may be grazed. Overgrazing reduces the protective cover and causes deterioration of desired grasses. A planned grazing system, proper grazing use, brush management, and timely deferment of grazing help to improve range condition.

The Inavale soils of this complex are suited to trees and shrubs in windbreaks if the species selected can withstand droughty soils. Soil blowing is the principal hazard and can be controlled by maintaining strips of sod between the rows. Irrigation may be needed during times of inadequate rainfall. The Boel soils are not suited to trees or shrubs in windbreaks, but in some cases plantings can be made by hand.

Soils in this complex are not suited to sanitary facilities and dwellings because of flooding, seepage, and wetness. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect roads from flood damage and wetness.

This map unit is assigned to capability unit VIw-7, dryland. The Inavale soils are in windbreak suitability group 7, and the Boel soils are in windbreak suitability group 10. A range site is not assigned.

La—Lamo silty clay loam, 0 to 1 percent slopes. This deep, somewhat poorly drained, nearly level soil is on bottom lands. This soil formed in silty, calcareous alluvium. Individual areas range from 5 to several hundred acres in size. This soil is subject to occasional flooding.

Typically, the surface layer is very dark gray, friable silty clay loam about 11 inches thick. The subsurface layer is dark gray, friable silty clay loam about 9 inches thick. The next layer is gray, firm silty clay loam about 12 inches thick. The underlying material is light brownish gray silty clay loam in the upper part and gray silty clay loam in the lower part to a depth of more than 60 inches. The soil is calcareous throughout. In a few small areas, the dark surface horizon is 12 to 20 inches thick. Other small areas have fine sand below a depth of 48 inches.

Included with this soil in mapping are small areas of Colo, Lawet, Ord, and Shell soils. Colo soils do not have carbonates, and they are on the same landscape as the Lamo soil. Lawet soils are poorly drained and are on lower landscapes. Ord soils have sand above 40 inches and are on similar landscapes. Shell soils are well drained and are higher on the landscape. The included soils make up 5 to 20 percent of this map unit.

Permeability of this Lamo soil is moderately slow, and the available water capacity is high. The soil has a seasonal water table that fluctuates from a depth of 1.5 feet in most wet years to about 3 feet in most dry years. During late summer it may recede to a depth of 5 feet. The organic matter content is moderate, and natural fertility is high. The rate of water intake is low. Runoff is

slow. This soil releases water readily to plants. The surface layer of this soil is easily tilled when dry or moist, but it is difficult to till when wet because the soil is sticky. Shrink-swell potential is high.

Most areas of this soil are used for cultivated crops. A few are in native or introduced grass. Some areas are irrigated.

Under dryland farming, this soil is suited to corn, grain sorghum, oats, and soybeans. Alfalfa can be grown for hay. The principal limitation is soil wetness. Tillage generally is delayed early in the spring. Tile drains can be installed or V-shaped drainage ditches can be constructed to help lower the seasonal high water table if suitable outlets are available. Keeping crop residue on the surface helps to maintain and improve the soil tilth. Conservation tillage practices, such as no-till planting or discing, help to maintain or increase organic matter content and reduce evaporation of soil moisture.

If irrigated, this soil is suited to both sprinkler and gravity systems of irrigation. Corn, grain sorghum, soybeans, and alfalfa can be grown. Wetness caused by the seasonal high water table is the main limitation. Tillage is commonly delayed in the spring of most years. Perforated tile can be installed or V-shaped drainage ditches can be constructed to help reduce wetness if suitable outlets are available. Land leveling helps to improve surface drainage and increases efficiency of irrigation systems. Conservation tillage practices, such as chiseling or discing, help to maintain the organic matter content and reduce evaporation of soil moisture.

If used for introduced grass pasture, this soil is suited to cool-season grasses, such as creeping foxtail, reed canarygrass, or orchardgrass, mixed with alfalfa. Warm-season grasses can also be grown. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Pastures can also be used in rotation with row crops. Overgrazing reduces the vegetative cover and causes deterioration of the grasses. Grazing when this soil is wet may cause the formation of small mounds and depressions, making grazing and haying difficult. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer can increase the vigor and growth of the grasses.

This Lamo soil is suited to native grasses that are used for rangeland. Overgrazing, untimely haying, and use of improper mowing heights reduce the protective plant cover and cause deterioration of the native plants. Grazing when the soil is wet can cause surface compaction. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native grasses in good condition.

This soil is well suited to trees and shrubs in windbreaks. It is suited to those species that tolerate a seasonal high water table and occasional flooding. Undesirable grasses and weeds are a concern in windbreaks. Weeds can be controlled by cultivation between the rows and by careful use of appropriate herbicides. Seedling establishment is a concern in wet years.

This soil is not suited to septic tank absorption fields or dwellings because of flooding and wetness. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material and providing adequate side ditches and culverts help protect roads from flood damage. Damage to roads by frost action can be reduced by providing good surface drainage and by use of a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches can provide the needed drainage. Roads also need to be designed so that the surface pavement and base are thick enough to compensate for low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance.

This soil is assigned to capability units IIw-4, dryland, and IIw-3, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

Lc—Lamo silty clay loam, wet, 0 to 1 percent slopes. This deep, poorly drained, nearly level soil is on bottom lands. It formed in silty alluvium. This soil is subject to occasional flooding. Individual areas range from 5 to 30 acres in size.

Typically, the surface soil is very friable silty clay loam about 16 inches thick. It is dark gray in the upper part and very dark gray in the lower part. The next layer, a transitional layer, is dark gray, firm silty clay loam about 12 inches thick. The underlying material is gray silty clay loam in the upper part and dark gray silty clay loam in the lower part to a depth of more than 60 inches. In some small areas, fine sand is below a depth of 40 inches. In other areas, the dark surface layer is 12 to 20 inches thick. Other small areas have a silty clay transitional layer and underlying material. Some small areas have shallow channels.

Included with this soil in mapping are small areas of Lawet, Loup, and Ord soils. Lawet soils have more sand in the profile and are on the same landscape as the Lamo soil. Loup soils have fine sand higher in the profile and are on similar landscapes. Ord soils are somewhat poorly drained and are slightly higher on the landscape.

Permeability is moderately slow in this Lamo soil, and the available water capacity is high. This soil has a seasonal high water table that fluctuates from a depth of about 0.5 foot in most wet years to a depth of about 1.5 feet in most dry years. The organic matter content is moderate, and natural fertility is high. Runoff is slow. This soil releases moisture readily to plants. Shrink-swell potential is high.

Nearly all of this soil is in native grass and is used for grazing or mowed for hay (fig. 8). Some small areas are used as habitat for wildlife.

Figure 8.—Native hay is a good use for the poorly drained Lamo silty clay loam, wet, 0 to 1 percent slopes. The seasonal high water table is near the surface in spring.

This soil is not suited to the common cultivated crops or to introduced grasses because it is too wet for tillage.

This soil is suited to native grasses that are used for rangeland. Overgrazing reduces the protective plant cover and causes deterioration of the native plants. Grazing when the soil is wet can cause surface compaction. Proper grazing use, timely deferment of grazing, and a planned grazing system help to keep the native grasses in good condition.

This soil is not suited to trees and shrubs in windbreaks because of excessive wetness from the high water table. Common species may be established by using special site treatment and hand plantings.

This Lamo soil is not suited to sanitary facilities and buildings because of the seasonal high water table and occasional flooding. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect roads from flood damage and wetness. Damage to roads by frost action can be reduced by providing good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability unit Vw-7, dryland, the Wet Land range site, and windbreak suitability group 10.

Le—Lamo silt loam, 0 to 1 percent slopes. This deep, nearly level, poorly drained soil is on bottom lands of Battle Creek Valley. This soil formed in silty alluvium high in organic matter. This soil floods occasionally. Individual areas of this map unit range from 5 to about 240 acres in size.

Typically, this soil has a dark gray, very friable silt loam surface layer about 7 inches thick. The subsurface layer is also dark gray, very friable silt loam about 11 inches thick. Next is a very friable silt loam layer that is very dark gray and about 6 inches thick. The underlying material is very dark gray silt loam to a depth of 60 inches. In some places, the surface layer is silty clay loam. Other small areas are better drained.

Included with this soil in mapping are small areas of Gibbon soils. Gibbon soils are better drained and are lower in organic matter content than the Lamo soil. In areas where artificial drainage is not used, 20 percent of this soil has a water table above 1 foot in most wet years.

Lamo silt loam has moderate permeability and high available water capacity. Runoff is very slow. Organic matter content is very high, and natural fertility is high. This soil has a seasonal high water table that fluctuates from a depth of 1 foot in most wet years to a depth of 3 feet in most dry years. It is generally highest in the spring. This soil releases moisture readily to plants. The surface layer is easily worked when dry.

Most of the acreage of this soil is drained by tile. Areas that are tiled are used for cultivated crops, and areas that are not tiled are in native grass and are used for grazing or mowed for hay.

If drained, this soil is suited to corn, sorghum, and soybeans. It is not well suited to spring-sown small grains and alfalfa because of wetness in early spring. Grasses can be grown for hay or pasture. The principal limitation is soil wetness, and tillage is generally delayed early in the spring. Tillage in the spring should be delayed until the soil dries out. Returning crop residue to the soil and keeping tillage to a minimum help to maintain organic matter content and fertility.

If drained, this soil is suited to irrigated crops. It is suited to both gravity and sprinkler irrigation systems. Irrigation is generally not needed in most years, but it may be beneficial in dry years. Soil wetness that delays tillage in the spring is the main limitation. This soil is best suited to corn and other row crops, but planting needs to be delayed in the spring of most years. Returning crop residue to the surface and keeping tillage to a minimum help maintain organic matter content and fertility.

This soil is suited to introduced grass pastures. It is suited to cool-season grasses, such as creeping foxtail and reed canarygrass, and to some warm-season grasses. Alternate pastures of cool-season and warm-season grasses can be used for a long grazing season. Overgrazing causes deterioration of the desired grasses. Grazing when the soil is wet can cause compaction and form mounds, making grazing or haying difficult. Proper stocking rates, rotational grazing, and weed control help to maintain the desired grasses. Applying nitrogen fertilizer normally improves the vigor and growth of grasses.

If left in native grass, this soil is well suited to grazing or hay. Overgrazing or improper haying methods, however, reduce the protective plant cover and cause deterioration of the desired grasses. In addition, overgrazing when the soil is wet can cause compaction and small mounds, making it difficult to graze or harvest for hay. Proper grazing use and timely deferment of grazing or haying, along with restricted use during wet periods, help maintain the desired plants.

This soil is well suited to trees and shrubs in windbreaks and to plantings for recreation and wildlife. Species selected should be able to tolerate wetness. Establishing seedlings can be difficult during wet years. Weeds and grasses can also be a problem. The soil should be tilled and seedlings planted after the soil has begun to dry. Weeds and grasses can be controlled by cultivating between the rows with conventional equipment. Appropriate herbicides can be used within the rows.

This Lamo soil is not suited to sanitary facilities and buildings because of a very high water table and occasional flooding. A suitable alternate site is needed. Roads can be constructed on suitable, compacted fill material and provided with adequate side ditches and culverts to help prevent flood damage and wetness. The roadbed can be graded to facilitate surface drainage, and using a gravel moisture barrier in the subgrade can reduce damage by frost action. The surface pavement of the road needs to be thick enough to compensate for the low strength of the soil.

This soil is assigned to capability units IIIw-3, dryland, and IIIw-3, irrigated, the Wet Subirrigated range site, and windbreak suitability group 2S.

Lf—Lawet loam, 0 to 1 percent slopes. This deep, poorly drained, nearly level soil is on bottom lands. This soil formed in calcareous, loamy alluvium. It is rarely flooded. Individual areas of this soil range from 5 to 50 acres in size.

Typically, the surface layer is dark gray, very friable loam about 10 inches thick. The subsurface layer is dark gray, very friable loam about 16 inches thick. The subsoil is dark gray, friable loam about 10 inches thick. The underlying material is gray sandy clay loam in the upper part and light gray fine sandy loam in the lower part to a depth of more than 60 inches. This soil is calcareous throughout the profile.

Included with this soil in mapping are small areas of Elsmere, Loup, Lamo wet, and Ord soils. The somewhat poorly drained Elsmere and Ord soils are slightly higher on the landscape than the Lawet soils. The sandy Loup soils and the silty Lamo wet soils are on similar landscapes. The included soils make up 5 to 20 percent of this map unit.

Permeability of this Lawet soil is moderate, and the available water capacity is high. Runoff is slow. This soil has a seasonal high water table that fluctuates from a depth of about 1 foot in most wet years to about 2 feet in most dry years. The water table is generally highest in spring. Organic matter content is high, and natural fertility is medium. The surface layer is easily tilled when the soil is dry. This soil releases moisture readily to plants.

Most of the acreage of this soil is in native grasses and is used for grazing or mowed for hay. Drainage is needed if dryland cultivated crops or introduced grasses are grown.

Under dryland farming, this soil is poorly suited to corn, sorghum, and soybeans because it has a seasonal high water table. This Lawet soil is not well suited to small grains. The principal limitation is soil wetness, and tillage is generally delayed early in the spring. Tile drains

can be installed or V-shaped drainage ditches can be constructed in some areas to lower the water table. Conservation tillage practices, such as discing or chiseling, keep crop residue on the surface and thereby help to maintain or increase the content of organic matter and fertility. Applying feedlot manure helps to maintain fertility.

This soil is not suited to irrigation crops because of the high water table. Drainage is needed, but outlets are commonly not available.

This soil is well suited to introduced grasses that can tolerate a seasonal high water table. If used for tame pasture, this soil is generally suited to cool-season grasses, such as creeping foxtail, reed canarygrass, and red clover, as well as to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Overgrazing or haying by improper methods reduce the protective plant cover and cause deterioration of the desired grasses. Grazing when the soil is wet causes formation of small mounds, making grazing or mowing for hay difficult. Proper stocking and rotational grazing help to keep desired grasses in good condition. Applying commercial nitrogen fertilizer can increase the growth and vigor of grasses.

This Lawet soil is suited to native grass that is used for grazing or mowed for hay. Most of the acreage of this soil is in rangeland. Overgrazing reduces the protective plant cover and causes deterioration of the desired grasses. Grazing when the soil is wet can cause compaction and the formation of small mounds and depressions. This makes haying and grazing difficult. Proper range use, timely deferment of grazing, and a planned grazing system help to keep the grasses in good condition.

This soil generally is poorly suited to trees and shrubs in windbreaks.

This soil is not suited to septic tank absorption fields or building sites because of wetness. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above the flood level and providing adequate side ditches and culverts help to protect roads from flood damage and wetness. Damage to roads by frost action can be reduced by providing good surface drainage and by using a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability unit IVw-4, dryland, the Subirrigated range site, and windbreak suitability group 10.

LgC—Libory loamy fine sand, 2 to 6 percent slopes. This deep, moderately well drained, gently sloping soil is on uplands. This soil formed in a layer of eolian sand and the underlying loess. Individual areas of this soil range from 10 to 160 acres in size.

Typically, the surface soil is dark grayish brown, very friable loamy fine sand about 14 inches thick. The subsoil is brown, friable loamy fine sand about 10 inches thick. The underlying material is silty clay loam. The upper part is light brownish gray, and the lower part is mottled light gray to a depth of more than 60 inches. Some small areas have a fine sandy loam surface layer, and other small areas are better drained than the Libory soil.

Included with this soil in mapping are small areas of Elsmere and Thurman soils. The somewhat poorly drained Elsmere soils are lower on the landscape than the Libory soil. Elsmere and Thurman soils have more sandy underlying material. The somewhat excessively drained Thurman soils are slightly higher on the landscape. Included soils make up about 5 to 12 percent of this map unit.

Permeability is rapid in the upper part of this Libory soil and moderate in the lower part. The available water capacity is moderate, and the rate of water intake is high. Runoff is slow. Organic matter content is moderately low, and natural fertility is medium. This soil has a perched water table that fluctuates between a depth of 1.5 feet in most wet years and a depth of 3 feet in most dry years. This soil releases water readily to plants. It is easily tilled throughout a fairly wide range of moisture conditions.

Most of the acreage of this soil is used for cropland. Both dryland and irrigated crops are grown. Some of the acreage is in native grass and is used for hay or grazing.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, and alfalfa. Small grains are grown in lesser amounts. The principal hazard is soil blowing. Conservation tillage practices, such as discing, chiseling, or a no-till planting system, help to conserve water and control soil blowing. Returning crop residue to the soil helps to maintain fertility and organic matter content, and planting field windbreaks helps to control soil blowing. Applying feedlot manure helps to increase fertility.

Under irrigation this soil is suited to corn, grain sorghum, soybeans, and alfalfa. This soil is suited to a sprinkler system of irrigation. A gravity system is effective if the soil is bench leveled to reduce runoff. Contour furrows are suited if used with terraces and grassed waterways and if crop residue is left on the surface. Soil blowing is the main hazard. No-till planting, discing, or chiseling keep crop residue on the surface and thereby help to conserve water, maintain fertility, and control soil blowing. Because of the high rate of water intake, frequent applications of water are needed. Applying feedlot manure helps to improve fertility.

This soil is suited to introduced grass pastures, and this use is an effective way to control soil blowing. The soil is suited to cool-season grasses, such as smooth brome or orchardgrass, mixed with alfalfa. It is also suited to warm-season grasses. Separate pastures of

cool-season and warm-season grasses can be used for a long grazing season. Pasture grasses can be used in rotation with row crops. Overgrazing or haying by improper methods reduces the protective grass cover and causes deterioration of the desired grasses. Rotational grazing, proper stocking, and weed control help to keep desired grasses in good condition. Applying nitrogen fertilizer and irrigation water can increase the vigor and growth of introduced grasses.

This soil is suited to native grass and is used for rangeland. Using this soil for range is a very effective way to control soil blowing. Overgrazing or haying by improper methods, however, reduces the protective cover and allows less desirable grasses and weeds to become established. Overgrazing can also result in soil losses by soil blowing. Proper grazing use, deferred grazing, and a planned grazing system help to maintain or improve range grasses.

This soil is fairly suited to trees and shrubs in windbreaks. Soil blowing, which can result in covering of seedlings by drifting sand during high winds, is a hazard. To prevent soil blowing, a cover crop should be maintained between the rows. Areas near the trees can be hoed by hand.

If septic tank absorption fields are constructed on this soil, fill material should be used to place the absorption fields a sufficient distance above the high water table. Dwellings need to be constructed on elevated, well compacted fill material to overcome wetness caused by the high water table. Constructing roads on suitable, well compacted fill material and providing adequate side ditches and culverts help protect roads from wetness.

This soil is assigned to capability units IIIe-6, dryland, and IIIe-10, irrigated, the Sandy range site, and windbreak suitability group 5.

Lo—Loretto fine sandy loam, 0 to 2 percent slopes. This deep, well drained, nearly level soil is on uplands and stream terraces. This soil formed in mixed eolian sand and loess. Individual areas of this soil range from 3 to 40 acres in size.

Typically, the surface layer is grayish brown, very friable fine sandy loam about 7 inches thick. The subsurface layer is dark grayish brown very friable fine sandy loam about 9 inches thick. The subsoil is about 36 inches thick. It is brown, friable loam in the upper part and pale brown, friable silt loam in the lower part. The underlying material is brown silt loam to a depth of more than 60 inches. In some areas, the surface layer is 20 to 26 inches thick. In other areas, this soil has sandy layers below a depth of 40 inches. Other small areas have a surface layer of loam.

Included with this soil in mapping are small areas of Blendon, Boelus, Nora, and Thurman soils. Blendon soils have more sand in the subsoil and are lower on the landscape than the Loretto soil. Boelus soils have more sand in the surface layer and are higher on the landscape. Nora soils have less sand throughout the profile and are on the same landscape. The somewhat excessively drained Thurman soils are higher on the landscape. The included soils make up 5 to 20 percent of this map unit.

Permeability is moderate in this Loretto soil. The available water capacity is high. Organic matter content is moderately low, and natural fertility is high. Runoff is slow. The rate of water intake is moderate. The surface layer is easily tilled throughout a wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is cultivated. Most areas are farmed dryland, but some are irrigated. A few small areas are in native grass or introduced grasses and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, oats, and alfalfa. Soil blowing is a hazard if the surface is not adequately protected by growing crops or crop residue. Conservation tillage practices, such as no-till planting for row crops, discing, or chiseling, help to prevent soil blowing and conserve soil moisture. Stripcropping and planting field windbreaks also help to prevent soil blowing. Applying feedlot manure helps to improve the organic matter content, fertility, and tilth of the soil.

Under irrigation, this soil is suited to corn, soybeans, grain sorghum, and alfalfa. This soil is suited to a sprinkler system. Gravity irrigation is effective if the soil is leveled to permit efficient application of the water. Soil blowing is the principal hazard. Conservation tillage practices, such as no-till planting for row crops, discing, or chiseling, keep crop residue on the surface and thereby help to control soil blowing and conserve soil moisture. Applying feedlot manure helps to maintain the organic matter content and improves the fertility of the soil.

This soil is suited to introduced grass pastures. It is suited to cool-season grasses, such as smooth brome, orchardgrass, and tall fescue, mixed with alfalfa, as well as to warm-season grasses. Introduced grasses can be used as part of a cropping sequence that includes row crops. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Proper stocking and rotational grazing help to keep the desired grasses in good condition. Applying nitrogen fertilizer and irrigation water increases the vigor and growth of grasses.

This soil is suited to rangeland. Overgrazing by livestock and haying at improper times or by improper methods reduce the protective plant cover and cause deterioration of desired grasses. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This Loretto soil is fairly well suited to trees and shrubs in windbreaks. Soil blowing is the main hazard. Competition for moisture from weeds and grasses is a

concern of management. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Cultivation generally needs to be restricted to the tree rows. Appropriate herbicides can be applied within the tree rows, or the area can be roto-tilled.

This soil is suited to septic tank absorption fields and to dwellings. Roads should be designed so that the surface pavement and base are thick enough to compensate for the low strength of this soil material. Using coarse grained material for subgrade or base material can ensure better performance.

This soil is assigned to capability units IIe-3, dryland, and IIe-5, irrigated, the Sandy range site, and windbreak suitability group 5.

LoC—Loretto fine sandy loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on uplands. It formed in mixed eolian sand and loess. Individual areas of this soil range from 3 to 40 acres in size.

Typically, the surface soil is very friable fine sandy loam about 13 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The subsoil is friable and about 29 inches thick. It is brown loam in the upper part and light yellowish brown silt loam in the lower part. The underlying material is silt loam. It is yellowish brown in the upper part and very pale brown in the lower part to a depth of more than 60 inches. Some small areas have a surface layer of loam. Other small areas have a surface layer 20 to 26 inches thick. Some small areas are nearly level.

Included with this soil in mapping are small areas of Boelus, Nora, and Thurman soils. Boelus soils have more sand in the surface layer and are on the same landscape as the Loretto soil. Nora soils have less clay in the surface layer and are lower on the landscape. The somewhat excessively drained Thurman soils are higher on the landscape. The included soils make up about 10 to 20 percent of this map unit.

Permeability is moderate in this Loretto soil, and the available water capacity is high. Organic matter content is moderately low, and natural fertility is high. The rate of water intake is moderate. Runoff is medium. The surface layer is easily tilled throughout a wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is in cultivated crops, but a few areas are in native or introduced grass and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, oats, and alfalfa. Soil blowing and water erosion are the main hazards. Conservation tillage practices that keep crop residue on the surface, such as discing, chiseling, or no-till planting, help to control soil blowing. Stripcropping also helps reduce soil blowing, and terraces and grassed waterways can be used to help control water erosion.

Under irrigation, this soil is suited to corn, grain sorghum, soybeans, and alfalfa. This soil is suited to sprinkler irrigation. It is suited to a gravity irrigation system if the site is bench leveled or terraced and contour furrowed to control runoff. Soil blowing and water erosion are the principal hazards. Maintaining fertility is a concern of management. Conservation tillage practices, such as discing, chiseling, or no-till planting, keep crop residue on the surface and thereby help to control both soil blowing and water erosion. Applying feedlot manure helps to maintain fertility and tilth of the soil.

This soil is suited to introduced grass pastures. Using this soil for pasture is an effective way to control soil blowing and water erosion. This soil is suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, that can be mixed with alfalfa. This soil is also suited to warm-season grasses. For a long grazing season, separate pastures of cool-season and warm-season grasses can be grown. Introduced grasses can be used as part of a cropping sequence that includes row crops. Proper stocking and rotational grazing help to keep the desired grasses in good condition. Application of fertilizer and irrigation water increases the vigor and growth of grasses.

This soil is suited to rangeland. Overgrazing by livestock and haying at the improper time or by improper methods reduce the protective plant cover and cause deterioration of desired grasses. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil generally is fairly well suited to trees and shrubs in windbreaks. Soil blowing and water erosion are the main hazards. Competition for moisture from weeds and grasses is a concern of management. Soil blowing can be controlled by maintaining a cover crop between the tree rows. Cultivation should be restricted to the tree rows. Planting trees on the contour and terracing can help prevent erosion and runoff. Appropriate herbicides can be applied within the rows, or the areas can be roto-tilled to control weeds and grasses.

This Loretto soil is generally suited to septic tank absorption fields and is suited to dwellings. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance.

This soil is assigned to capability units IIIe-3, dryland, and IIIe-5, irrigated, the Sandy range site, and windbreak suitability group 5.

Lp—Loretto loam, 0 to 2 percent slopes. This deep, well drained, nearly level soil is on uplands and stream terraces. This soil formed in mixed eolian sand and

loess. Individual areas of this soil range from 5 to 40 acres in size.

Typically, the surface layer is very dark gray, very friable loam about 7 inches thick. The subsurface layer is very dark grayish brown, very friable loam about 8 inches thick. The subsoil is friable silt loam about 24 inches thick. The upper part is brown, and the lower part is pale brown. The underlying material is silt loam. The upper part is light yellowish brown, and the lower part to a depth of more than 60 inches is light brownish gray. In some areas, the dark surface layer is 20 to 26 inches thick. Some small areas have sandy loam below a depth of 40 inches. Other small areas have a surface layer of fine sandy loam.

Included with this soil in mapping are small areas of Boelus, Nora, and Thurman soils. Boelus soils have more sand in the surface layer and are higher on the landscape than the Loretto soil. Nora soils have less sand in the surface layer and are higher on the landscape. The somewhat excessively drained Thurman soils are higher on the landscape. The included soils make up 5 to 15 percent of this map unit.

Permeability is moderate in this Loretto soil, the rate of water intake is moderately low, and the available water capacity is high. Organic matter content is moderate, and natural fertility is high. Runoff is slow. The surface is easily tilled throughout a fairly wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is cultivated. Some of the acreage is irrigated. A few small areas are in native grass and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, and small grain. It is also suited to alfalfa. Maintenance of a high level of fertility is the main concern of management. Row crops can be grown year after year if weeds, diseases, and insects are controlled. Conservation tillage practices, such as discing, chiseling, or no-till planting, leave crop residue on the surface and thereby help to maintain organic matter content and prevent soil blowing. Applying feedlot barnyard manure also helps maintain fertility.

Under irrigation, this soil is suited to corn, soybeans, grain sorghum, and alfalfa. This soil is suited to both sprinkler and gravity irrigation systems. Land leveling increases the efficiency of irrigation systems, and, in some areas, may be needed for gravity irrigation. Conservation tillage practices, such as discing or chiseling, help to improve tilth and control water runoff. Management of irrigation water is a concern. Applying feedlot manure and returning crop residue to the soil help to increase the water infiltration rate in areas disturbed by land leveling.

This soil is suited to introduced grass pastures. It is suited to cool-season grasses, such as smooth bromegrass or orchardgrass, mixed with alfalfa. It is also suited to warm-season grasses. Adjacent pastures of cool-season and warm-season grasses can be used for a long grazing season. Pasture can be used as part of a cropping system. Proper stocking, rotational grazing, and weed control help to keep the desired grasses in good condition. Overgrazing reduces the protective cover and causes deterioration of the desired grasses. Applying water and nitrogen fertilizer increases the vigor and growth of grasses.

This soil is suited to rangeland. Overgrazing by livestock and haying at the improper time or by improper methods reduce the protective plant cover and cause deterioration of desired grasses. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This Loretto soil is fairly well suited to trees and shrubs in windbreaks. The main limitation is competition for moisture from weeds and grasses. Weeds and grasses can be controlled by cultivating between the tree rows with conventional equipment. Careful use of appropriate herbicides or hand hoeing within the rows can help to control weeds and grasses. Irrigation may be needed to provide supplemental moisture during periods of low rainfall.

This soil is suited to septic tank absorption fields and to buildings. Damage to roads by frost action can be reduced by providing good surface drainage and by the use of a gravel moisture barrier in the subgrade. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance.

This soil is assigned to capability units I-1, dryland, and I-4, irrigated, the Silty range site, and windbreak suitability group 3.

LpC—Loretto loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on side slopes of uplands. This soil formed in mixed eolian sand and loess. Individual areas range from 3 to 60 acres in size.

Typically, the surface layer is grayish brown, very friable loam about 7 inches thick. The subsurface layer is dark grayish brown, very friable loam about 5 inches thick. The subsoil is friable silt loam about 25 inches thick. It is brown in the upper part and pale brown in the lower part. The underlying material is silt loam. It is pale brown in the upper part and very pale brown and calcareous in the lower part to a depth of more than 60 inches. In some small areas, the surface layer is silt loam or fine sandy loam. In some areas, the dark surface layer is 20 to 26 inches thick. Other small areas are nearly level.

Included with this soil in mapping are small areas of Boelus, Hobbs, Nora, and Thurman soils. Boelus soils have more sand in the surface layer and are on the

same landscape as the Loretto soil. Hobbs soils have a stratified silty profile and are in narrow drainageways lower on the landscape. Nora soils have less sand throughout, have lime higher in the profile, and are lower on the landscape. Thurman soils are somewhat excessively drained and are slightly higher on the landscape. The included soils make up about 5 to 20 percent of this map unit.

Permeability is moderate in this Loretto soil, and the available water capacity is high. Organic matter content is moderate, and natural fertility is high. The water intake rate is moderately low. Runoff is medium. The surface layer is easily tilled throughout a fairly wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is in cultivated crops. A few areas are in native or introduced grass and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, oats, and alfalfa. Water erosion is the principal hazard. Maintaining fertility is the main management concern. Conservation tillage practices, such as discing, chiseling, or no-till planting, help to control erosion. Terraces, contour farming, and grassed waterways on the long, smooth slopes also help to prevent water erosion. Returning crop residue to the soil helps to maintain the organic matter content.

If irrigated, this soil is suited to a sprinkler system of irrigation. This soil can be bench leveled for a gravity system. Corn, grain sorghum, soybeans, and alfalfa can be grown under irrigation. Under gravity irrigation, contour furrows are suitable if used with terraces and grassed waterways and if an adequate amount of crop residue is maintained on the surface. Because of the uneven slope of this soil, water erosion and runoff are concerns unless water application is controlled. Conservation tillage practices, such as discing and chiseling the long smooth slopes, help to control erosion and runoff. Land leveling increases the efficiency of irrigation systems. Returning crop residue to the soil and applying fertilizer and feedlot manure help to maintain the organic matter content and fertility.

This soil is suited to introduced grass pastures. It is suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa, as well as to warm-season grasses. Alternate pastures of cool-season and warm-season grasses can be grown for a long grazing season. Pastures can also be used as part of a cropping sequence with row crops. Rotational grazing and proper stocking help to keep the desired grasses in good condition. Applying nitrogen fertilizer and irrigation water increases the vigor and growth of grasses.

This soil is fairly well suited to trees and shrubs in windbreaks. Water erosion is the principal hazard. Competition for moisture from weeds and grasses is a concern of management. Trees can be planted on a terraced contour to help control erosion. Cultivation between the rows can be used to control weeds and undesirable grasses. In addition, appropriate herbicides can be used.

This soil is suited to septic tank absorption fields and to dwellings. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance.

This soil is assigned to capability units IIe-1, dryland, and IIIe-4, irrigated, the Silty range site, and windbreak suitability group 3.

Lt—Loup loamy fine sand, wet, 0 to 1 percent slopes. This deep, very poorly drained, nearly level soil is on bottom lands of drainageways in the uplands and in swales of the Elkhorn River Valley. It formed in sandy alluvium. It is subject to ponding. Individual areas range from 5 to 25 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loamy fine sand about 6 inches thick. The subsurface layer is dark grayish brown, friable loamy fine sand about 7 inches thick. The next layer is grayish brown, very friable loamy fine sand about 6 inches thick. The underlying material, to a depth of more than 60 inches, is fine sand. It is mottled and light brownish gray in the upper part and mottled and light gray in the lower part. Some areas have a fine sandy loam or loam surface layer. Other small areas have thin silt layers in the upper part of the underlying material. Some small areas have a surface layer 3 to 10 inches thick.

Included with this soil in mapping are small areas of Thurman, Elsmere, Lawet, Marlake, and Inavale soils. Thurman and Inavale soils are somewhat excessively drained and are higher on the landscape than the Loup soil. The somewhat poorly drained Elsmere soils are slightly higher on the landscape. Lawet soils have less sand in the profile and are slightly higher on the landscape. Marlake soils have a higher seasonal water table and are slightly lower on the landscape. The included soils make up 5 to 15 percent of this map unit.

Permeability is rapid in this Loup soil, and the available water capacity is low. Runoff is ponded. Organic matter content is high, and natural fertility is low. This soil has a seasonally high water table that fluctuates from 6 inches above the surface in most wet years to about 1 foot below the surface in most dry years. It is generally highest in the spring. This soil releases moisture readily to plants.

Nearly all of this soil is in native grass that is mowed for hay. Some areas are grazed, and some areas are used for wildlife habitat.

This soil is generally not suited to the common cultivated crops or to introduced grasses because of the seasonal high water table.

Rangeland or hayland are the best uses for this soil. Haying at improper times and at improper mowing heights reduces the protective plant cover and thereby causes deterioration of the native plants. Grazing can cause small mounds or bogs, making it difficult to harvest the grass for hay.

This soil is not suited to trees and shrubs in windbreaks because of excessive wetness from the high water table. In some cases, trees and shrubs can be planted only if special treatments are applied, such as hand planting, scalp planting, and drainage.

This Loup soil is not suited to septic tank absorption fields or dwellings because of ponding. The walls or sides of shallow excavations need to be temporarily shored to prevent sloughing or caving. Constructing roads on suitable, well compacted fill material above the ponding level and providing adequate side ditches and culverts help to protect roads from damage by ponding and from the seasonal high water table.

This soil is assigned to capability unit Vw-7, dryland. A capability unit for irrigation is not assigned. This soil is in the Wet Land range site and windbreak suitability group 10.

Ma—Marlake loam, 0 to 1 percent slopes. This deep, nearly level, very poorly drained soil is on low bottom lands of the Elkhorn River Valley. This soil formed in sandy alluvium. It is subject to frequent ponding. Individual areas range from 5 to 20 acres in size.

Typically, 2 inches of partly decayed organic matter is at the surface. The mineral soil has a surface layer of dark gray, very friable loam about 7 inches thick. The next layer is gray, very friable loamy fine sand about 10 inches thick. The underlying material is light gray fine sand to a depth of more than 60 inches. In some small areas, the surface layer is loamy fine sand or fine sand. In some small places, the soil is better drained and the surface layer is thicker.

Included with this soil in mapping are small areas of Boel and Ord soils. Boel and Ord soils are better drained and are higher on the landscape than Marlake soils. Included soils make up 2 to 10 percent of this map unit.

Permeability in this Marlake soil is rapid. Runoff is ponded. Available water capacity is low. Organic matter content is high, and natural fertility is low. The seasonal high water table is about 2 feet above the surface in most wet years and at a depth of about 1 foot in most dry years. During some prolonged dry periods, the water table may recede to as low as 2 feet below the surface.

Most of the acreage of this soil is in natural vegetation, such as cattail and arrowhead, and is best suited to wildlife habitat.

This soil is not suited to cultivated crops, grass, or trees because of the high water table. It is best suited to use as habitat for wetland wildlife (fig. 9).

Figure 9.—Areas of Marlake loam, 0 to 1 percent slopes, are best suited to wetland wildlife.

This Marlake soil is not suited to sanitary facilities or dwellings because of frequent ponding of water. A suitable alternate site is needed. Roads can be constructed on suitable, well compacted fill material above the ponding level. Adequate side ditches and culverts can be provided to help protect roads from damage caused by ponding and wetness from the seasonal high water table.

This soil is assigned to capability unit VIIIw-7 and windbreak suitability group 10. It is not assigned a range site.

Mo—Moody silty clay loam, 0 to 2 percent slopes. This deep, well drained, nearly level soil is on the crest of the broad ridgetops of the uplands. It formed in loess. Areas range from 5 to 75 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is about 34 inches thick. It is dark grayish brown, firm silty clay loam in the upper part; brown, friable silty clay loam in the middle part; and pale brown, friable clay loam in the lower part. The underlying material is light yellowish brown, calcareous silt loam to a depth of more than 60 inches. In some areas, the surface layer is 6 to 12 inches thick. In small areas, the depth to lime is greater than 60 inches. In other small areas, the depth to lime is 20 to 30 inches.

Included with this soil in mapping are small areas of Belfore and Fillmore soils. Belfore soils have more clay in the subsoil and are on the same landscape as the Moody soil. Fillmore soils are poorly drained and are slightly lower on the landscape. The included soils make up 2 to 8 percent of this map unit.

Permeability is moderately slow in this Moody soil, the rate of water intake is low, and available water capacity is high. Runoff is slow. Organic matter content is moderate, and natural fertility is high. Tilth is fair. Good tillage is possible only within a limited range of soil moisture content. This soil releases moisture readily to plants. Shrink-swell potential is moderate.

Most of the acreage of this soil is farmed dryland. A small acreage is irrigated. A few areas are in introduced grasses, and a few areas are in trees and shrubs that are used for farmstead windbreaks.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, grasses, and legumes. Weed control and maintenance of a high level of fertility are the main concerns of management. Conservation tillage practices, such as discing or chiseling, help to maintain the tilth and workability of this soil. Row crops can be grown year after year if weeds, diseases, and insects are controlled. Returning crop residue to the soil and applying feedlot manure help to maintain organic matter content and fertility.

Under irrigation, corn, grain sorghum, soybeans, and alfalfa can be grown. This soil is suited to both gravity and sprinkler systems of irrigation. In some areas, land leveling may be needed for gravity irrigation. Land leveling increases the efficiency of irrigation systems. Applying feedlot manure and using conservation tillage practices that keep crop residue on the surface help to maintain or improve organic matter content, fertility, and soil tilth.

This soil is suited to introduced pasture. It is suited to cool-season grasses, such as smooth brome or orchardgrass, mixed with alfalfa. It is also suited to warm-season grasses. Adjacent pastures of cool-season and warm-season grasses can be used for a long grazing season. Pasture can be used as part of a cropping system. Grazing when wet can cause compaction of the soil. Overgrazing reduces the protective plant cover and causes deterioration of the desired grasses. Proper stocking and rotational grazing help to keep the desired grasses in good condition. Applying nitrogen fertilizer and irrigation water increases the growth and vigor of introduced grasses.

This soil is suited to rangeland. Overgrazing by livestock and haying at the improper time or by improper methods reduce the protective plant cover and cause deterioration of desired grasses. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This Moody soil is well suited to most species of trees and shrubs that can tolerate the climate. Competition from undesirable grasses and weeds is a management concern. Grasses and weeds can be controlled by cultivation between the tree rows and by careful use of appropriate herbicides or by roto-tilling within the row.

The moderately slow permeability of this Moody soil is a limitation for septic tank absorption fields, but this limitation may be overcome by increasing the size of the absorption area. Foundations for buildings need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. Roads need to be designed so that the surface pavement is thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance. Crowning the roadbed by grading and constructing adequate side ditches can provide good surface drainage and thereby reduce damage to roads by frost action.

This soil is assigned to capability units I-1, dryland, and I-3, irrigated, the Silty range site, and windbreak suitability group 3.

MoC—Moody silty clay loam, 2 to 6 percent slopes. This deep, well drained, gently sloping soil is on crests and side slopes of broad ridgetops of the uplands. It formed in loess. Individual areas range from 5 acres to several hundred acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is

firm silty clay loam about 32 inches thick. It is dark grayish brown in the upper part, brown in the middle part, and yellowish brown and light yellowish brown in the lower part. The underlying material is calcareous silt loam. It is light yellowish brown in the upper part and very pale brown in the lower part to a depth of more than 60 inches. Depth to lime is about 39 inches. In a few small areas, the depth to lime is greater than 60 inches, and in a few other small areas, the depth to lime is less than 30 inches. Thirty to forty percent of the acreage of this unit is moderately eroded. In these areas, the surface layer is slightly thinner and lighter in color than is typical.

Included with this soil in mapping are small areas of Belfore and Fillmore soils. Belfore soils are nearly level and are higher on the landscape than the Moody soil. The somewhat poorly drained Fillmore soils are in shallow depressions. Some small areas that have soils high in alkali or sodium are included. The included soils make up about 3 to 12 percent of this map unit.

Permeability of this Moody soil is moderately slow, and the available water capacity is high. Runoff is medium. Organic matter content is moderate, and natural fertility is high. The rate of water intake is low. Tilth is fair. Good tillage is possible only within a limited range of soil moisture content. This soil releases moisture readily to plants. Shrink-swell potential is moderate.

Most of the acreage of this soil is in cultivated crops. A few areas are in native grass or are seeded to introduced grasses and used for grazing or mowed for hay. Many areas are irrigated.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, oats, and alfalfa. The principal hazard is erosion by water. Conservation tillage practices, such as discing, chiseling, or no-till planting, leave crop residue on the surface and thereby help to control erosion and conserve soil moisture. Terraces, contour farming, and grassed waterways help to prevent erosion on the long, smooth slopes. Grasses and legumes can be included in the cropping system to control erosion and maintain organic matter content.

If irrigated, this soil is suited to sprinkler irrigation (fig. 10). It is suited to a gravity system in areas where the soil is bench leveled or where contour furrowing, terraces, and grassed waterways are used and an adequate amount of crop residue is left on the surface. Corn, grain sorghum, soybeans, and alfalfa can be grown under irrigation. Erosion is the main hazard. Runoff is a management concern. Controlling the application rate of irrigation water helps to reduce runoff. Conservation tillage practices that keep crop residue on the surface, terraces, and contour furrowing also help to control water runoff.

For pastures of introduced grasses this soil is suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa. It is also suited to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used to supply a long grazing season. Pastures can be used in rotation with cultivated crops. Overgrazing or untimely haying reduces the protective plant cover and causes deterioration of desired grasses. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water increases the vigor and growth of pasture grasses.

This soil is suited to rangeland. Use of this soil for range is effective in controlling water erosion. Overgrazing by livestock and haying at the improper time or at improper mowing heights reduce the protective cover and cause deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive and grow well if competing vegetation is controlled. Seedling survival and growth can be improved by good site preparation and timely cultivation between the tree rows or careful use of appropriate herbicides within the rows. Planting trees on the contour and terracing help to control runoff and erosion. Irrigation can provide supplemental moisture during periods of low rainfall.

The moderately slow permeability of this Moody soil is a limitation for septic tank absorption fields, but this limitation can generally be overcome by increasing the size of the absorption field. The foundations for buildings need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Coarse-textured material for subbase or base material can be used. Crowning the roadbed by grading and constructing adequate side ditches can provide good surface drainage and reduce damage to roads by frost action.

This soil is assigned to capability units IIe-1, dryland, and IIIe-3, irrigated, the Silty range site, and windbreak suitability group 3.

Mp—Moody silty clay loam, terrace, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on high stream terraces. This soil formed in loess. Individual areas of this soil range from 5 acres to several hundred acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is brown, friable silty clay loam about 23 inches thick. The underlying material is pale brown, calcareous silt loam to a depth of more than 60 inches. Some small areas have a silt loam surface layer. Some small areas are gently sloping.

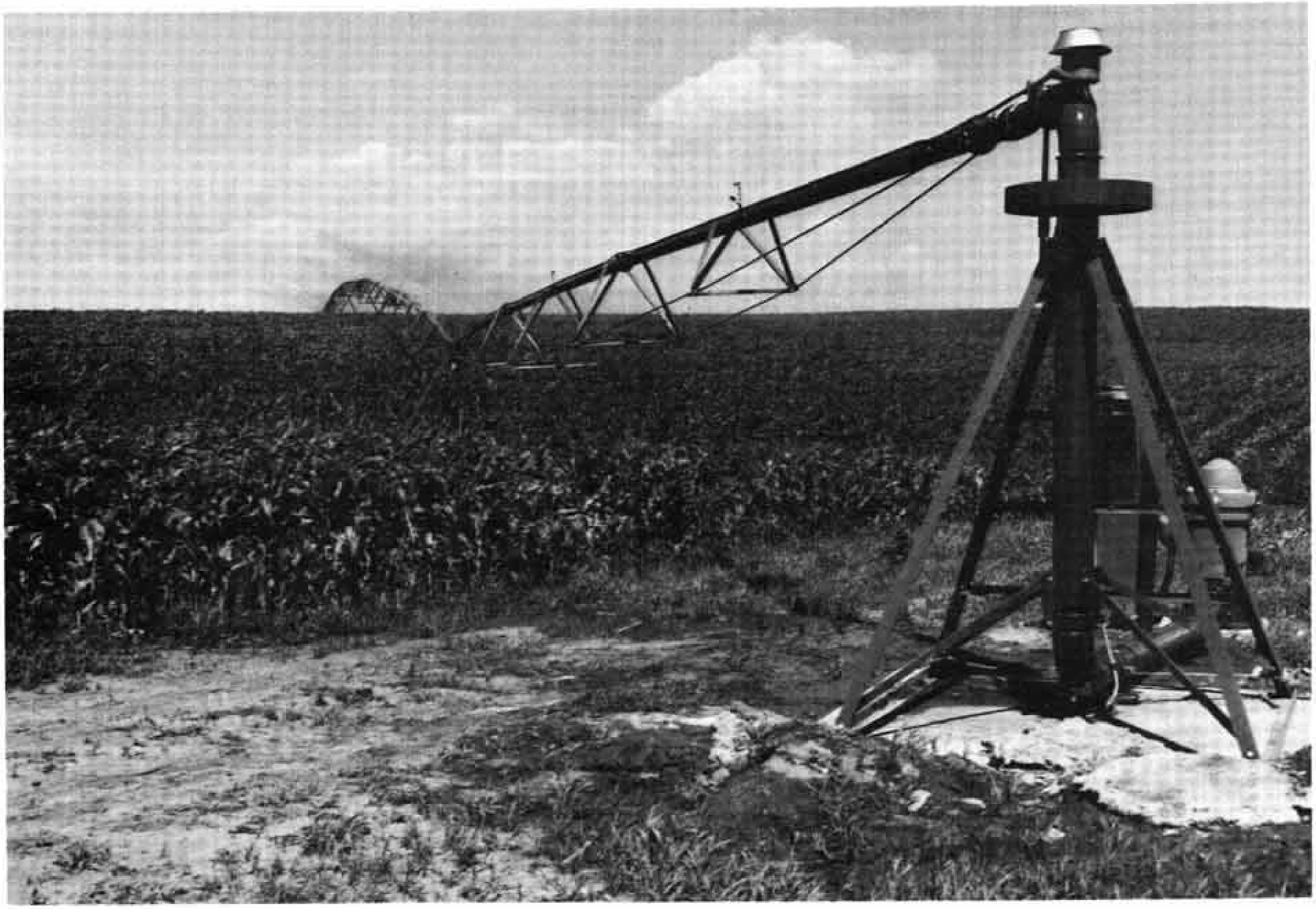

Figure 10.—A center-pivot sprinkler system is used to irrigate this Moody silty clay loam, 2 to 6 percent slopes.

Some small areas have a dark surface layer 20 to 26 inches thick.

Included with this soil in mapping are small areas of Fillmore soils. The poorly drained Fillmore soils are slightly lower on the landscape than the Moody soil. The included soils make up about 3 to 8 percent of this map unit.

Permeability is moderately slow in this Moody soil, and the available water capacity is high. Runoff is slow. Organic matter content is moderate, and natural fertility is high. The rate of water intake is low. Tilth is fair. Good tillage on this soil is possible only within a limited range of soil moisture content. Shrink-swell potential is moderate.

This soil is used mainly for cultivated crops. Most of the acreage is irrigated. Some small areas are in native grass or are seeded to introduced grasses and used for hay or grazing.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, oats, and alfalfa. Maintaining fertility and tilth are the principal concerns of management. Conservation tillage practices, such as discing, no-till planting, or till-planting, keep crop residue on the surface and thereby help to prevent erosion and conserve soil moisture.

If irrigated, this soil is suited to gravity and sprinkler irrigation systems. Corn, soybeans, and alfalfa are the main irrigated crops. Some land leveling is generally needed for gravity irrigation. Land leveling improves surface drainage and increases the efficiency of the irrigation system. Conservation tillage practices, such as no-till planting and discing, keep crop residue on the surface and help to conserve soil moisture. Returning crop residue to the soil and adding feedlot manure also help to increase the content of organic matter and maintain fertility of the soil.

This soil is suited to introduced grass pastures and is used for grazing or mowed for hay. It is suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa. It is also suited to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used for a long

grazing season. Pasture grasses can be used as part of a cropping sequence that includes row crops. Overgrazing or untimely mowing causes deterioration of the desired grasses. Rotational grazing, proper stocking, and timely mowing help to keep the desired grasses in good condition. Applying nitrogen fertilizer and irrigation water increases the growth and vigor of pasture grasses.

This Moody soil is suited to rangeland. Overgrazing by livestock and haying at the improper time or by improper methods reduce the protective cover and cause deterioration of the desired grasses. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil is well suited to trees and shrubs in windbreaks. Competition for moisture from undesirable weeds and grasses is the main concern of management. Cultivation between the rows, careful use of appropriate herbicides, or roto-tilling within the tree rows helps control plant competition. Areas near the trees can be hoed by hand.

The moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this limitation can be overcome by increasing the size of the absorption field. The foundations for buildings need to be strengthened and backfilled with coarse material to prevent damage by shrinking and swelling of the soil. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse textured material for base material or subgrade can ensure better performance. Crowning the road by grading and constructing adequate side ditches help to provide good surface drainage and reduce damage to roads by frost action.

This soil is assigned to capability units I-1, dryland, and I-3, irrigated, the Silty range site, and windbreak suitability group 3.

Mu—Muir silty clay loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on low stream terraces. This soil formed in silty alluvium. This soil is subject to rare flooding. Individual areas range from 3 acres to several hundred acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 28 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material is brown silt loam to a depth of more than 60 inches. Some small areas have very dark grayish brown underlying material. Other small areas have a dark surface layer 10 to 20 inches thick. Other small areas are gently sloping. In a few places, silty clay is below a depth of 20 inches.

Included with this soil in mapping are small areas of Gibbon, Hobbs, and Shell soils. The somewhat poorly drained Gibbon soils are slightly lower on the landscape than the Muir soil. The Hobbs soils are in narrow drainageways that cross the Muir soil. Shell soils are stratified below a depth of 20 inches and are lower on the landscape. The included soils make up about 5 to 10 percent of this map unit.

Permeability is moderate in this Muir soil, and the available water capacity is high. Organic matter content is moderate, and natural fertility is high. Runoff is slow. The rate of water intake is slow. Tilth is fair. Good tillage is possible only within a limited range of soil moisture content. This soil releases moisture readily to plants.

Most of the acreage of this soil is cultivated, but a few areas are in grass and are used for grazing or mowed for hay. Many areas are irrigated.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, and legumes. Weed control and fertility maintenance are the main concerns of management. Conservation tillage practices, such as discing, chisel-planting, and no-till planting, help to maintain the tilth and workability of the soils. Leaving crop residue on the soil also helps to conserve soil moisture.

This soil is suited to both sprinkler and gravity systems of irrigation. Corn, soybeans, grain sorghum, and alfalfa can be grown under irrigation. If irrigated, this soil has few limitations. Maintaining fertility is the main concern of management. Land leveling is generally needed for gravity irrigation. Conservation tillage systems, such as discing or no-till planting, keep crop residue on the surface and thereby help to conserve soil moisture and improve organic matter content.

This soil is suited to introduced grass pastures. It is suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, that can be mixed with alfalfa. It is also suited to warm-season grasses. A combination of cool-season grasses and warm-season grasses in separate pastures can be used for a long grazing season. Pasture grasses can be used as part of the cropping system. Overgrazing reduces the protective cover and causes deterioration of the desired grasses. Proper stocking and rotational grazing help to keep the grasses in good condition. Irrigated pastures respond to nitrogen fertilizer.

This Muir soil is suited to rangeland. Overgrazing by livestock and haying at the improper time or by improper methods reduce the protective cover and cause deterioration of desired grasses. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Healthy seedlings of common species, properly planted in a well prepared site generally survive and grow well. Cultivation between rows or careful use of appropriate

herbicides can help to control weeds and undesirable grasses. Newly planted trees may need watering during periods of low rainfall.

Flooding is a rare hazard, but it needs to be considered if this soil is used for sanitary facilities and building sites. To minimize the damage caused by flooding, fill material can be used to elevate septic tank absorption fields and dwelling sites. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance.

This soil is assigned to capability units I-1, dryland, and I-3, irrigated, the Silty Lowland range site, and windbreak suitability group 1.

NoC—Nora silty clay loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on ridgetops and side slopes of uplands. This soil formed in loess. Individual areas of this soil range from 3 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 8 inches thick. The subsoil is friable silty clay loam about 20 inches thick. The upper part is brown, the middle part is pale brown, and the lower part is pale brown and calcareous. The underlying material is calcareous silt loam. It is light yellowish brown in the upper part and very pale brown in the lower part to a depth of more than 60 inches. In a few small areas, the surface layer is lighter colored than is typical. In a few areas, depth to lime ranges from 30 to 50 inches. Also, small areas of this soil are strongly sloping.

Included with this soil in mapping are small areas of the calcareous Crofton soils that are on the same landscape as the Nora soil. The included soils make up about 10 to 15 percent of this map unit.

Permeability, the rate of water intake, and runoff are moderate in areas of this Nora soil, and the available water capacity is high. The organic matter content is moderate, and natural fertility is high. The soil is easily tilled throughout a fairly wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is cultivated, but a few areas are in introduced grass or native grass and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, and oats. It is also suited to alfalfa. A slight hazard of water erosion and the need to maintain fertility and good tilth are management concerns. Conservation tillage practices, such as discing or chiseling, help to control erosion and maintain good tilth. Terraces, contour farming, and grassed waterways help prevent erosion on the long, smooth slopes. Returning crop residue to the soil and applying feedlot manure help to maintain fertility.

If irrigated, this soil is suited to sprinkler irrigation. It is suited to a gravity system if it is bench leveled or if contour furrows are supplemented by terraces and grassed waterways and an adequate amount of crop residue is left on the surface. Corn, soybeans, grain sorghum, and alfalfa can be grown under irrigation. Management concerns are the hazards of water erosion and runoff and the need to maintain fertility and good tilth. Land leveling decreases runoff, increases the efficiency of irrigation systems, and helps to control erosion. The rate of water application needs to be controlled. Conservation tillage practices that keep crop residue on the soil, terracing, and contour furrowing help to control runoff water.

Use of this soil for introduced grass pasture is an effective way to control erosion. For pasture, this soil is generally suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa. Warm-season grasses can also be grown. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Pasture can also be used in a crop sequence with row crops. Overgrazing, grazing when the soil is wet, and haying by improper methods reduce the protective cover and cause deterioration of desired grasses. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying commercial nitrogen fertilizer and irrigation water increases the growth and vigor of grasses.

This soil is suited to rangeland, and using this soil for range is an effective way to control water erosion. Overgrazing by livestock or haying by improper methods, however, reduces the protective plant cover and causes deterioration of desired grasses. Reduction of the protective cover can cause severe soil losses by water erosion. A planned grazing system, proper grazing use, and timely deferment of grazing help to maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Seedlings generally survive and grow well on this soil. Water erosion and drought are hazards, and moisture competition from weeds and grasses is a limitation. Planting trees on the contour and on terraces helps to prevent erosion and control runoff. Undesirable grasses and weeds can be controlled by cultivation between the trees and by careful use of appropriate herbicides. Areas next to the trees can be hoed by hand. Irrigation can provide supplemental moisture during dry periods.

This soil is suited to septic tank absorption fields. Foundations for buildings need to be strengthened and backfilled with coarse materials to prevent damage by shrinking and swelling of the soil. Roads need to be designed so that the surface pavement is thick enough to compensate for low strength of the soil material. Using coarse grained material for subgrade or base material ensures better performance. Crowning the roadbed by grading and constructing adequate side ditches can provide good surface drainage and reduce road damage caused by frost action.

This soil is assigned to capability units IIe-1, dryland, and IIIe-3, irrigated, the Silty range site, and windbreak suitability group 3.

NoD—Nora silty clay loam, 6 to 11 percent slopes. This deep, strongly sloping, well drained soil is on side slopes of uplands. It formed in loess. Individual areas of this soil range from 3 to 100 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is friable silty clay loam 22 inches thick. The upper part is brown, and the lower part is pale brown and calcareous. The silt loam underlying material is pale yellow in the upper part and very pale brown in the lower part to a depth of more than 60 inches. In some small areas of this soil, lime is below a depth of 30 inches. In places, the soil is eroded and has a surface layer that is lighter in color than is typical. In some small areas the soil is gently sloping or moderately steep.

Included with this soil in mapping are small areas of Alcester, Crofton, Hobbs, and Thurman soils. Alcester soils are on foot slopes that are lower on the landscape than the Nora soil. Crofton soils are slightly higher on the landscape. Hobbs soils are below the Nora soil on the landscape. Hobbs soils are on bottom lands of narrow drainageways and are occasionally flooded. Thurman soils are somewhat excessively drained and are on similar landscapes. The included soils make up about 10 to 15 percent of the map unit.

Permeability and organic matter content are moderate in this Nora soil. Available water capacity is high. Natural fertility is high. The rate of water intake is moderate. Runoff is rapid. This soil releases moisture readily to plants. Tilth is fair. This soil can be easily tilled only within a narrow range of soil moisture content.

Most of the acreage of this soil is in cultivated crops. A few areas are in introduced and native grasses and are used for grazing or mowed for hay. Some cultivated areas are irrigated by sprinklers.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, oats, and alfalfa. Water erosion is the principal hazard. Erosion can be controlled by terraces and grassed waterways. Conservation tillage practices, such as discing, chiseling, or no-till planting, keep crop residue on the surface and thereby help to control erosion.

If irrigated, this soil is poorly suited to a sprinkler system and is not suited to gravity irrigation. If irrigated, it is better suited to close growing crops, such as alfalfa, than to row crops; but row crops can be grown if erosion control practices are used. Controlling runoff and maintaining fertility are the main management concerns. Applying water at the proper rate and using terraces and grassed waterways help to control water erosion and runoff. If this soil is used for row crops, conservation tillage practices, such as discing, chiseling, or no-till planting, can be used in conjunction with contour farming to help control erosion and maintain good tilth.

This soil is suited to introduced grass pastures. Use of this soil for pasture is an effective way to control erosion. This soil is suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa. Warm-season grasses can also be grown. Separate pastures of cool-season and warm-season grasses can provide a long grazing season. Pasture grasses can also be used in rotation with cultivated row crops. Overgrazing or mowing at improper heights reduces the protective plant cover and causes deterioration of desired grasses. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water increases the vigor and growth of pasture grasses.

This soil is suited to native grass that is used for rangeland. Using this soil for rangeland is an effective way to control erosion. Overgrazing by livestock and haying at improper times or at improper mowing heights reduce the protective plant cover and cause deterioration of desired grasses. Reduction of protective cover can result in severe soil losses by water erosion. A planned grazing system, proper grazing use, and timely deferment of grazing help to maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Erosion by water and drought are hazards, and competition for moisture from weeds and grasses is a limitation. Water erosion can be reduced by planting trees on the contour and terracing or planting a cover crop between the rows. Undesirable grasses and weeds can be controlled by cultivation between the trees and by careful use of appropriate herbicides within the rows.

Land shaping and installing distribution lines on the contour are needed to ensure the proper operation of septic tank absorption fields on this soil. Dwellings need to be designed to accommodate the slope, or the site can be graded. In addition, foundations need to be strengthened and backfilled with coarse material to prevent damage by shrinking and swelling of the soil. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil. Using coarse grained material for subgrade or base material can ensure better performance. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIIe-1, dryland, and IVe-3, irrigated, the Silty range site, and windbreak suitability group 3.

NoE—Nora silty clay loam, 11 to 15 percent slopes. This deep, moderately steep, well drained soil is on side slopes of uplands. This soil formed in loess.

Individual areas of this soil range from 3 to 30 acres in size.

Typically, the surface layer is dark grayish brown, very friable silty clay loam about 7 inches thick. The subsoil is friable silty clay loam about 23 inches thick. The upper and middle parts are brown, and the lower part is pale brown and calcareous. The underlying material is pale brown, calcareous silt loam to a depth of more than 60 inches. In some small areas, lime is at a depth of more than 30 inches. In some small areas, the surface layer is lighter in color than is typical. In small areas the soil is strongly sloping.

Included with this soil in mapping are small areas of Alcester, Crofton, and Hobbs soils. Alcester soils are on foot slopes below the Nora soil. Crofton soils are on the same landscape as the Nora soil. Hobbs soils are occasionally flooded and on bottom lands of narrow drainageways below the Nora soils. The included soils make up about 10 to 15 percent of this map unit.

Permeability and organic matter content are moderate in this Nora soil. Natural fertility is medium. Available water capacity is high. Runoff is rapid. This soil releases moisture readily to plants. Good tillage on this soil is possible only within a limited range of soil moisture content. Shrink-swell potential is moderate.

Most of the acreage of this soil is cultivated, but a large acreage is in native or introduced grasses and is used for grazing or mowed for hay.

Under dryland farming, this soil is poorly suited to corn and grain sorghum. It is better suited to alfalfa, oats, and close-grown crops. Water erosion is the principal hazard. Erosion and runoff can be controlled by terraces and grassed waterways. Conservation tillage practices, such as discing, chiseling, or a no-till planting system, keep crop residue on the surface and thereby help to control erosion and runoff.

This soil is not suited to irrigation because of slope. The hazard of erosion is severe.

This soil is suited to introduced grass pasture, and using it for pasture is an effective way to control water erosion. This soil is suited to cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa. Warm-season grasses can also be grown. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Pasture grasses can be used in rotation with cultivated row crops. Overgrazing reduces the protective plant cover and causes deterioration of desired grasses. Proper stocking and rotational grazing help to keep grasses in good condition. Applying nitrogen fertilizer increases the growth and vigor of grasses.

This soil is suited to native grasses for rangeland. Using it for range is an effective way to control erosion. Overgrazing by livestock and haying at improper times or at improper mowing heights reduce the protective plant cover and cause deterioration of desired grasses. Reduction of protective cover can cause severe soil losses by water erosion. A planned grazing system, proper degree of use, and timely deferment of grazing help to maintain or improve the range condition.

This soil is fairly well suited to trees and shrubs in windbreaks. Water erosion and drought are the main hazards. Planting trees on the contour and terracing help to control erosion and runoff. Undesirable grasses and weeds can be controlled by cultivation between the tree rows and careful use of appropriate herbicides or roto-tilling within the rows.

Land shaping and installing distribution lines on the contour are needed to ensure the proper operation of septic tank absorption fields. Dwellings need to be properly designed to accommodate the slope, or the site can be graded. In addition, foundations for buildings need to be strengthened and backfilled with coarse materials to prevent damage by shrinking and swelling of the soil. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance. Damage to roads and streets by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability unit IVe-1, dryland, the Silty range site, and windbreak suitability group 3.

NpC2—Nora-Crofton complex, 2 to 6 percent slopes, eroded. This map unit consists of deep, well drained, gently sloping soils on narrow ridgetops of uplands. These soils formed in loess. Areas of this map unit range from 5 to 30 acres in size. The Nora soils in this complex are on side slopes and are lower on the landscape than the Crofton soils. The Crofton soils are generally on ridgetops. About 40 to 55 percent of this map unit is Nora soils, and 35 to 45 percent is Crofton soils. The individual areas of these soils are so intricately mixed that it is not practical to separate them at the scale used in mapping. Rills are common after heavy rains. Erosion has removed most of the original surface layer and, in places, part of the subsoil. In the areas of Nora soils, the remaining part of the surface layer has been mixed with part of the subsoil by tillage.

Typically, the Nora soils have a surface layer of brown, friable silty clay loam about 5 inches thick. The subsoil is friable silty clay loam about 20 inches thick. It is yellowish brown in the upper part and light yellowish brown and calcareous in the lower part. The underlying material is very pale brown, calcareous silt loam to a depth of more than 60 inches. In some small areas, the depth to lime is more than 30 inches.

Typically, the Crofton soils have a surface layer of brown, very friable silt loam about 5 inches thick. In many areas, the underlying material is exposed, and lime concretions are on the surface. The underlying material

is calcareous silt loam. It is pale brown in the upper part and light yellowish brown in the lower part to a depth of more than 60 inches.

Included with this complex in mapping are small areas of reddish brown and gray soil material. The inclusions make up 3 to 8 percent of this complex.

Permeability in both the Nora and Crofton soils is moderate, and the available water capacity is high. Organic matter content is moderately low in the Nora soils and low in the Crofton soils. Runoff is medium. The rate of water intake is moderate in both soils. The soils in this map unit are generally deficient in phosphorus and zinc. Natural fertility is medium in the Nora soils and low in the Crofton soils. The surface layer of the Crofton soil is very friable and is easily tilled through a fairly wide range of moisture conditions. The surface layer of the Nora soil is not so friable, and good tillage is possible only within a limited range of soil moisture. Moisture is released readily to plants.

Most of the acreage of this complex is cultivated, but some areas are in introduced grasses that are used for grazing or mowed for hay.

Under dryland farming, these Nora and Crofton soils are suited to corn, soybeans, grain sorghum, oats, and alfalfa. Water erosion is the principal hazard. Conservation tillage practices, such as discing, chiseling, and no-till planting, keep crop residue on the surface and thereby help to prevent excessive soil and water loss. Contouring also helps to reduce soil loss and conserve moisture. Returning crop residue to the soil helps to maintain and improve the content of organic matter and to increase fertility. Applications of feedlot manure and commercial fertilizer also help to improve fertility.

If irrigated, these soils are suited to gravity irrigation. Under this system the soils can be bench leveled or they can be contour furrowed and supplemented by terraces, grassed waterways, and maintenance of an adequate amount of crop residue on the surface. Extensive land leveling is needed for a gravity system, and deep cuts are commonly required. These soils are better suited to sprinkler irrigation than to gravity irrigation, but conservation tillage practices, such as discing, chiseling, and no-till planting, are needed to control runoff and erosion in areas irrigated by a sprinkler system. Under irrigation, the soils in this complex are better suited to close-grown crops than to row crops. Row crops can be grown, but irrigation water needs to be carefully controlled. Applications of feedlot manure or commercial fertilizer are needed to maintain the organic matter content and improve the fertility of these soils.

Soils of this Nora-Crofton complex are suited to introduced grass pastures, and using these soils for pasture is an effective way to control erosion. Cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, can be mixed with alfalfa. These soils are also suited to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Pasture grasses can also be used as part of a cropping sequence that includes row crops. Overgrazing causes deterioration of desired grasses. Proper stocking, rotational grazing, and weed control help to keep desired grasses in good condition. Applying nitrogen fertilizer and irrigation water increases the growth and vigor of grasses.

These Nora and Crofton soils are suited to native grass for rangeland, and using them for range is an effective way to control both wind and water erosion. Overgrazing by livestock and haying at improper times or at improper mowing heights reduce the protective cover and permit less productive grasses and weeds to become established. Overgrazing also results in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help to maintain and improve the range condition. Seeding native grasses may be needed on severely eroded areas of cropland in order to establish a protective plant cover that can control erosion.

These soils are fairly well suited to trees and shrubs in windbreaks. Capability is good for the survival and fair for the growth of suitable species. Drought and competition for moisture from weeds and undesirable grasses are the main management concerns. Irrigation can provide supplemental moisture during periods of inadequate rainfall. Competition from weeds and grasses can be controlled by cultivating between the rows and by careful use of appropriate herbicides with the rows. Areas near the trees can be hoed by hand. On the Crofton soil, trees and shrubs that tolerate excessive amounts of lime should be planted.

These soils are suited to septic tank absorption fields. The Crofton soils are suited to the construction of dwellings. In areas of the Nora soils, foundations of dwellings need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. Dwellings need to be properly designed to accommodate the slope or the site can be graded. Roads need to be designed so that the surface pavement and base are thick enough to compensate for low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance. In areas of Nora soils, crowning the road by grading and constructing adequate side ditches can help to provide good surface drainage and reduce damage by frost action.

This map unit is assigned to capability units IIIe-8, dryland, and III-3, irrigated. The Nora soils are in the Silty range site, and the Crofton soils are in the Limy Upland range site. The Nora soils are in windbreak suitability group 3, and the Crofton soils are in windbreak suitability group 8.

NpD2—Nora-Crofton complex, 6 to 11 percent slopes, eroded. This complex consists of deep, well drained, strongly sloping soils on ridgetops and side

slopes of uplands. These soils formed in loess. Erosion has removed most of the original surface layer. In areas of the Nora soils, tillage has mixed the upper part of the subsoil with the remaining part of the surface layer; and if cultivated, areas of these soils are patchy brown and grayish brown. Rills are common after heavy rains. Areas of this complex range from 10 to several hundred acres in size. About 45 to 65 percent of this map unit is Nora soils on the lower side slopes, and 30 to 45 percent is Crofton soils on the narrow ridgetops and upper side slopes. Areas of the individual soils are so small or so intricately mixed that it is not practical to separate them at the scale used in mapping.

Typically, the Nora soils have a surface layer of grayish brown, friable silty clay loam about 5 inches thick. The friable silty clay loam subsoil is about 25 inches thick. It is yellowish brown in the upper part and pale brown and calcareous in the lower part. The underlying material is light yellowish brown and very pale brown, calcareous silt loam to a depth of more than 60 inches. Lime is at a depth of about 16 inches. In some areas, the surface layer is silt loam. In other small areas, the depth to lime is more than 30 inches.

Typically, the Crofton soils have a surface layer of brown, very friable, calcareous silt loam about 5 inches thick. The underlying material is calcareous silt loam. It is pale brown in the upper part and very pale brown in the lower part to a depth of more than 60 inches. Small lime concretions are commonly on the surface and throughout the soil.

Included with this complex in mapping are small areas of Alcester and Hobbs soils. Alcester soils are on foot slopes lower on the landscape than the soils of this Nora-Crofton complex. The occasionally flooded Hobbs soils are on bottom lands of intermittent drainageways below the Nora and Crofton soils. In some small areas, the soil material is gray, and in other areas, it is reddish brown. The included soils make up about 5 to 20 percent of this map unit.

Permeability is moderate and available water capacity is high in both the Nora and Crofton soils. Runoff is rapid. The rate of water intake is moderate in both soils. The organic matter content is moderately low in the Nora soils and in the Crofton soils. Natural fertility is medium in the Nora soils and low in the Crofton soils. The surface layer of the Crofton soils is very friable and easily tilled throughout a fairly wide range of moisture conditions. Good tillage of the surface layer of the Nora soils is possible only within a limited range of soil moisture content. Both soils release moisture readily to plants. The Crofton soils are low in available phosphorus and zinc.

Most of the acreage of this map unit is cultivated, but a few areas are in introduced grass and are used for grazing.

Under dryland farming, these soils are suited to corn, soybeans, grain sorghum, oats, and alfalfa. Water erosion and drought are the principal hazards. Conservation tillage practices, such as discing, chiseling, and no-till planting, help to prevent erosion and conserve soil moisture. Terraces and grassed waterways also help to prevent water erosion. Applying feedlot manure and commercial fertilizers helps to increase the fertility of these soils.

These soils are poorly suited to irrigation. Only a sprinkler system can be used. Under irrigation, these soils are better suited to close-sown crops and legumes than to row crops. Corn, soybeans, and grain sorghum can be grown if the irrigation water is properly managed. Water erosion is the principal hazard. Terraces (fig. 11) and grassed waterways help to control erosion and runoff. Conservation tillage practices, such as discing and chiseling, help to control erosion and conserve soil moisture. If pivot irrigation is used, care needs to be taken to prevent erosion in areas of wheel tracks. Applying feedlot manure and commercial fertilizers and returning crop residue to the soil help to maintain or improve the organic matter content and fertility of these soils.

Soils in this complex are suited to introduced grass pastures, and using these soils for pasture is an effective way to control erosion. Cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, can be mixed with alfalfa. Warm-season grasses can also be grown. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Pastures can also be used in rotation with cultivated crops. Overgrazing reduces the protective cover and causes deterioration of the desired grasses. Proper stocking and rotational grazing help to keep the desired grasses in good condition and control weeds. Applying nitrogen fertilizer and irrigation water increases the vigor and growth of grasses.

The soils of this complex are suited to rangeland. Using these soils for range is an effective way to control both wind and water erosion. Overgrazing by livestock and haying at the improper time or at improper mowing heights reduce the protective cover and permit less productive grasses and weeds to become established. Overgrazing also results in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help to maintain and improve the range condition. Seeding native grasses may be needed on severely eroded areas of cropland to establish a protective cover that can control erosion.

These soils are fairly well suited to trees and shrubs in windbreaks. Drought, competition for moisture from weeds and grasses, and water erosion are the main management concerns. Cultivation between the rows and careful use of appropriate herbicides within the rows help to control undesirable weeds and grasses. Planting trees on the contour and terracing help to control erosion and runoff. Irrigation can provide supplemental moisture during periods of inadequate rainfall. In areas of

Figure 11.—Terraces and grassed waterways on the Nora-Crofton complex, 6 to 11 percent slopes.

the Crofton soil, trees and shrubs that tolerate an excessive amount of calcium carbonate should be planted.

Land shaping and installing distribution lines on the contour are needed for the construction of septic tank absorption fields on these soils. Dwellings need to be designed to accommodate the slope, or the site can be graded. Foundations for buildings on areas of the Nora soils need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance. Crowning the roadbed by grading and constructing adequate side ditches can provide good surface drainage and reduce the damage by frost action.

This map unit is assigned to capability units IIIe-8, dryland, and IVe-3, irrigated. The Nora soils are in the Silty range site, and the Crofton soils are in the Limy Upland range site. Nora soils are in windbreak suitability group 3, and Crofton soils are in windbreak suitability group 8.

Og—Ord fine sandy loam, 0 to 2 percent slopes. This deep, somewhat poorly drained, nearly level soil is on bottom lands of the Elkhorn River Valley. This soil formed in stratified alluvium. It is subject to occasional flooding. Individual areas of this soil range from 3 to 80 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 7 inches thick. The subsurface layer is also dark grayish brown, very friable fine sandy loam about 11 inches thick. The next layer is grayish brown, friable fine sandy loam about 14 inches

thick. The underlying material is pale brown. It is loamy fine sand in the upper part and mottled fine sand in the lower part to a depth of more than 60 inches. In a few small areas, the surface layer is loam. In other small areas, the surface layer is 20 to 26 inches thick.

Included with this soil in mapping are small areas of Boel, Cass, and Inavale soils. Boel soils have fine sand higher in the profile and are slightly lower on the landscape than the Ord soil. The well drained Cass soils are slightly higher on the landscape. The somewhat excessively drained Inavale soils are higher on the landscape. The included soils make up about 5 to 15 percent of this map unit.

Permeability is moderately rapid in this Ord soil, and the available water capacity is moderate. Runoff is slow. This soil has a seasonal high water table that fluctuates from a depth of about 1.5 feet in most wet years to about 3.5 feet in most dry years. The water table is generally highest in spring and is commonly at a depth of about 3 feet during the growing season. Organic matter content is moderately low, and natural fertility is medium. The rate of water intake is moderately high. The surface layer is easily tilled throughout a fairly wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is cultivated, but some areas are in native grass that is used for grazing or mowed for hay. A small acreage is irrigated.

Under dryland farming, this soil is suited to corn, soybeans, and grain sorghum. It is also suited to legumes. Spring-sown small grain is generally not grown because of wetness in early spring. V-shaped drainage ditches or perforated tile can be used to improve drainage if a suitable outlet is available. Soil blowing is a hazard if the surface layer is not protected by a plant cover. Conservation tillage practices that keep all or most of the crop residue on the surface help to prevent soil blowing and reduce evaporation of soil moisture.

If irrigated, this soil is suited to both gravity and sprinkler systems. It is suited to corn, grain sorghum, soybeans, and alfalfa. Because of soil wetness, tillage is commonly delayed in the spring of most years. Tile drains can be installed or V-shaped drainage ditches can be constructed if a suitable outlet is available. Land leveling helps to improve the surface drainage and increases efficiency of the irrigation system. Deep cuts that expose the fine sand underlying material should be avoided. Frequent, light applications of water help to prevent leaching of water and herbicides through the soil. Conservation tillage practices, such as no-till planting, keep crop residue on the surface and thereby help to control soil blowing and conserve soil moisture.

This soil is suited to introduced grass pastures or hay. It is suited to cool-season grasses, such as creeping foxtail or reed canarygrass, mixed with alfalfa, as well as to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Pasture grasses can be alternated with row crops in the cropping system. Overgrazing reduces the protective cover and causes deterioration of desired grasses. Proper stocking, rotational grazing, and weed control help to keep the grasses in good condition. Pasture grasses generally respond to nitrogen fertilizer and irrigation water.

The use of this soil for rangeland is an effective way to control soil blowing. Overgrazing, untimely haying, and mowing at improper heights reduce the protective plant cover and cause deterioration of native grasses. A planned grazing system, proper grazing use, timely deferment of grazing, and restriction on use during very wet periods help to keep the grasses in good condition.

This soil is well suited to trees and shrubs that can tolerate a seasonal high water table and occasional flooding. Establishment of trees can be difficult in wet years. Soil blowing is a hazard. Undesirable grasses and weeds can be controlled by cultivation between the trees and by careful use of appropriate herbicides. Areas near the trees can be hoed by hand.

This soil is not suited to septic tank absorption fields because of flooding, wetness, and the poor filtering ability of the sandy underlying material. A suitable alternate site is needed. The walls or sides of shallow excavations should be temporarily shored to prevent sloughing or caving. This soil is not suited to the construction of buildings because of the flooding and the wetness from the seasonal high water table. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect roads from flood damage and wetness. In addition, using a gravel moisture barrier in the subgrade and crowning the roadbed by grading help to provide good drainage and reduce damage by frost action.

This soil is assigned to capability units IIw-6, dryland, and IIw-8, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

Oh—Ord loam, 0 to 1 percent slopes. This deep, somewhat poorly drained, nearly level soil is on the bottom lands of the Elkhorn River Valley. This soil formed in stratified alluvium. It is subject to occasional flooding. Individual areas range from 3 to 80 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. The subsurface layer is dark grayish brown, friable fine sandy loam about 9 inches thick. Below this is a layer of grayish brown, very friable fine sandy loam about 8 inches thick. The underlying material is light brownish gray, fine sandy loam in the upper part, light gray fine sand in the middle part, and light brownish gray, mottled fine sand in the lower part to a depth of more than 60 inches. In a few small areas, the surface layer is fine sandy loam. In

other small areas, the surface layer is 20 to 26 inches thick.

Included with this soil in mapping are small areas of Cass, Gibbon, and Inavale soils. The well drained Cass soils are slightly higher on the landscape than the Ord soil. The Gibbon soils have more clay above 40 inches and are slightly higher on the landscape. The somewhat excessively drained Inavale soils are higher on the landscape. The included soils make up about 5 to 15 percent of this map unit.

Permeability is moderately rapid in this Ord soil, and the available water capacity is moderate. Runoff is slow. This soil has a seasonal high water table that fluctuates from a depth of about 1.5 feet in most wet years to about 3.5 feet in most dry years. It is generally highest in the spring and is commonly at a depth of 3 feet during the growing season. Organic matter content is moderately low, and natural fertility is medium. The rate of water intake is moderately high. The surface layer is easily tilled throughout a fairly wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is cultivated, but some areas are in native grass and are used for grazing or mowed for hay. Some areas are irrigated.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, and alfalfa. Spring-sown grains are generally not grown because of wetness in early spring. The principal hazard on this soil is wetness, which delays tillage early in the spring. V-shaped drainage ditches can be constructed or tile can be installed to improve drainage if a suitable outlet is available. Conservation tillage practices, such as discing or no-till planting, keep crop residue on the surface and thereby help to improve the organic matter content and conserve soil moisture. Cover crops help to prevent runoff and soil blowing. Applying feedlot manure helps to improve the fertility of this soil.

If irrigated, this soil is suited to both gravity and sprinkler systems. It is suited to corn, grain sorghum, soybeans, and alfalfa. Because of soil wetness, tillage is commonly delayed in spring of most years. Tile can be installed or V-shaped drainage ditches can be constructed if a suitable outlet is available. Land leveling helps to improve surface drainage and increase the efficiency of the irrigation system. Deep cuts that expose the fine sand underlying material should be avoided. Frequent, light applications of water are needed to prevent leaching of water and herbicides through the soil. Returning crop residue to the soil and applying feedlot manure help to maintain fertility. Conservation tillage practices, such as no-till planting, keep crop residue on the soil surface and thereby help to maintain organic matter content and conserve soil moisture.

This soil is suited to introduced pasture grasses for grazing or hay. Cool-season grasses, such as creeping foxtail or reed canarygrass, can be mixed with alfalfa. This soil is also suited to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Pasture grasses can be alternated with row crops in the crop rotation. Overgrazing reduces the protective plant cover and causes deterioration of the desired grasses. Grazing when the soil is wet can cause compaction. Proper stocking and rotational grazing help to keep the grasses in good condition. Pasture grasses generally respond to nitrogen fertilizer and irrigation water.

This soil is suited to rangeland and can be used for grazing or haying. Overgrazing, untimely haying, and use of improper mowing heights cause deterioration of the native plants. Grazing when the soil is wet can cause compaction. Proper grazing use, timely deferment of grazing, and restriction on grazing during very wet periods help to maintain the native plants in good condition.

This soil is well suited to trees and shrubs that can tolerate a seasonal high water table and occasional flooding. The establishment of seedlings can be difficult in wet years. Undesirable grasses and weeds are a common concern. Grass and weeds can be controlled by cultivating between the rows and by careful use of appropriate herbicides. Areas near the trees can be hoed by hand.

This soil is not suited to septic tank absorption fields because of wetness, flooding, and the poor filtering ability of the sandy underlying material. A suitable alternate site is needed. Walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. This soil is not suited to the construction of buildings because of flooding and soil wetness. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect roads from flood damage and wetness. In addition, using a gravel moisture barrier in the subgrade and crowning the roadbed by grading help to reduce damage to roads by frost action.

This soil is assigned to capability units IIw-4, dryland, and IIw-8, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

OtC—Ortello fine sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. The soil formed in mixed eolian sands and loess. Areas range from 5 to 40 acres in size.

Typically, the surface layer is dark grayish brown, very friable fine sandy loam about 8 inches thick. The subsurface layer is also dark grayish brown, very friable fine sandy loam about 7 inches thick. The subsoil is brown, friable fine sandy loam about 15 inches thick. The underlying material is fine sand. It is light yellowish brown in the upper part and pale brown in the lower part to a depth of more than 60 inches. In some areas, the surface layer is loam, and in other small areas, it is

loamy fine sand. In other small areas, the surface layer is 20 to 26 inches thick.

Included with this soil in mapping are small areas of Boelus, Loretto, and Thurman soils. Boelus and Loretto soils have more clay in the subsoil and are on landscape positions similar to those of the Ortello soil. Thurman soils are somewhat excessively drained and on about the same landscape. The included soils make up about 10 to 15 percent of this map unit.

Permeability is moderately rapid in the subsoil and rapid in the underlying material of this Ortello soil. Available water capacity is moderate. Organic matter content is moderately low, and natural fertility is high. The rate of water intake is moderately high. Runoff is slow. The surface layer is easily tilled throughout a wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is used for cultivated crops, but a few areas are in native grass or are seeded to introduced grasses and used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, grain sorghum, oats, soybeans, and alfalfa. Soil blowing and water erosion are the principal hazards. Conservation tillage practices, such as discing or chiseling, keep crop residue on the surface and help to control erosion and conserve soil moisture. Cover crops are also effective in controlling erosion and conserving moisture. This soil is droughty during years of below average rainfall. Contour farming, stripcropping, and field windbreaks reduce the risk of erosion and help to conserve moisture.

If irrigated, this soil is suited to a gravity system of irrigation, but a sprinkler irrigation system is generally more practical. Corn, grain sorghum, and alfalfa can be grown under irrigation. Applications of water should be light but frequent to prevent the leaching of nutrients below root depth. Conservation tillage practices, such as discing, chiseling, or no-till planting, keep crop residue on the surface and thereby help to control erosion and conserve moisture. Returning crop residue to the soil and applying feedlot manure help to maintain the organic matter content and improve fertility.

This soil is suited to introduced grass pastures or hay, and using this soil for pasture is an effective way to control erosion. Cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, can be mixed with alfalfa. This soil is also suited to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Proper stocking and rotational grazing help to keep desired grasses in good condition. Applying nitrogen fertilizer and irrigation water improves the vigor and growth of grasses.

This soil is suited to rangeland, and using this soil for range is an effective way to control soil blowing and water erosion. Overgrazing by livestock and haying at improper times or at improper mowing heights reduce the protective plant cover and cause deterioration of the native plants. These practices can also cause severe losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help to maintain or improve the range condition.

This soil is fairly well suited to trees and shrubs in windbreaks. Soil blowing is the principal hazard. Droughtiness and competition for moisture from weeds and grasses are the main management concerns. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the tree rows. Weeds and grasses can be controlled by roto-tilling or by using appropriate herbicides within the tree rows.

This soil is suited to use as septic tank absorption fields if extreme care is taken to ensure that pollution by seepage does not contaminate the ground water. The walls or sides of shallow excavations should be temporarily shored to prevent sloughing or caving. This soil is suited to the construction of dwellings. Crowning the roadbed by grading and constructing adequate side ditches can provide good surface drainage and thus reduce damage to roads by frost action.

This soil is assigned to capability units IIIe-3, dryland, and IIIe-8, irrigated, the Sandy range site, and windbreak suitability group 5.

Ov—Ovina fine sandy loam, 0 to 2 percent slopes. This deep, somewhat poorly drained, nearly level soil is on low stream terraces and bottom lands. This soil formed in loamy alluvium. It is subject to rare flooding. Individual areas range from 5 to 50 acres in size.

Typically, the surface layer is dark gray, very friable fine sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown, very friable fine sandy loam about 10 inches thick. The underlying material is stratified light gray and light brownish gray, calcareous loam, fine sandy loam, and very fine sandy loam to a depth of more than 60 inches. In some areas, the dark surface layer is 20 to 26 inches thick. In some areas, the surface layer is loamy fine sand. Some small areas are better drained than is typical.

Included with this soil in mapping are small areas of Boelus, Elsmere, Loretto, Ord, and Thurman soils. Boelus and Loretto soils are well drained and are higher on the landscape than the Ovina soil. Elsmere soils have more sand in the profile and are higher on the landscape. Ord soils have more sand in the profile and are lower on the landscape. Thurman soils are somewhat excessively drained and are higher on the landscape. Included soils make up 10 to 20 percent of this map unit.

Permeability of this Ovina soil is moderate. Available water capacity is high, and the rate of water intake is moderately high. Runoff is slow. Organic matter content is moderate, and natural fertility is medium. This soil has a seasonal high water table that fluctuates from a depth of about 1 foot in most wet years to about 3 feet in most

dry years. It is commonly highest in the spring. This soil tends to warm up more slowly in spring than do the better drained soils. The surface layer is easily tilled throughout a fairly wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is cultivated, but some areas are in native grass that is used for hay or grazing. Some areas are irrigated by sprinkler irrigation systems.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, and alfalfa. Spring-sown small grain is generally not grown because of wetness in early spring. The principal limitation is soil wetness, which delays tillage early in the spring. Soil blowing is a hazard if the protective cover is removed. Tiling may be beneficial if suitable outlets are available. Conservation tillage practices, such as discing, chiseling, and no-till planting, keep most of the crop residue on the surface and thereby help to prevent runoff and soil blowing. Returning crop residue to the soil helps to maintain the organic matter content and fertility. Applying feedlot manure also helps to maintain fertility.

If irrigated, this soil is suited to both gravity and sprinkler systems. It is suited to corn, grain sorghum, alfalfa, and soybeans. Because of soil wetness, tillage is commonly delayed in spring of most years. Tile drains can be installed or V-shaped drainage ditches constructed if suitable outlets are available. Land leveling improves the surface drainage and increases the efficiency of irrigation systems. Conservation tillage practices, such as discing and no-till planting, that keep crop residue on the soil surface help to control soil blowing and thereby conserve soil moisture.

This soil is suited to introduced grasses for tame pasture. Using this soil for pasture is an effective way to control soil blowing. Cool-season grasses, such as reed canarygrass and creeping foxtail, can be grown. Warm-season grasses can also be grown. Separate pastures, one of cool-season grasses and one of warm-season grasses, can be used for a long grazing season. Pasture can be used as part of a cropping system that is alternated with row crops. Overgrazing reduces the protective plant cover and causes deterioration of the desired grasses. Grazing when the soil is wet can cause compaction and small mounds. Proper stocking and rotational grazing help to keep the grasses in good condition. Pasture grasses are well suited to irrigation and respond to nitrogen fertilizer.

This soil is suited to rangeland that is used for grazing or mowed for hay. Using this soil for range is an effective way to control soil blowing. Overgrazing, untimely haying, and use of improper mowing heights reduce the protective plant cover and permit less desirable grasses and weeds to become established. Grazing when the soil is wet results in compaction. Proper grazing use, timely deferment of grazing, and restriction on use during wet periods help to maintain the desired grasses.

This Ovina soil is well suited to trees and shrubs in windbreaks. The trees and shrubs selected should tolerate wetness from the seasonal high water table. Establishment of seedlings can be a problem during wet years. Undesirable grasses and weeds can be controlled by cultivation between the tree rows and by careful use of appropriate herbicides. Areas near the trees can be hoed by hand.

Flooding is a rare hazard, but it needs to be considered if this soil is used for sanitary facilities and building sites. Septic tank absorption fields can be constructed on fill material in order to raise the absorption field a sufficient distance above the seasonal high water table. Dwellings can be constructed on elevated, well compacted fill material as protection against flooding and from wetness caused by the high water table. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect the roads from flood damage and wetness. Damage to roads by frost action can be reduced by providing good surface drainage and by use of a gravel moisture barrier in the subgrade. Crowning the roadbed by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIIw-5, dryland, and IIIw-10, irrigated, the Subirrigated range site, and windbreak suitability group 2S.

Pb—Pits and Dumps. This unit consists mainly of mounds of gravel, sand, and overburden, and adjacent pits that contain water. The sand and gravel dumps are used as storage areas for construction materials used mainly for buildings and roads. Also stored in these areas are the pumping equipment, roads, and loading docks used in mining sand and gravel. Areas range from 5 to 80 acres in size.

Typically, the material to a depth of more than 60 inches consists of a mixture of fine, medium, and coarse sand and fine gravel. The material is mostly recently deposited waste sand. There is no development of a soil profile.

Included with this unit in mapping are small areas of Boel and Inavale soils. Both of these soils are lower in elevation than the sand dumps but higher than the pit areas. These areas have not been disturbed or covered by sand or gravel. The included soils make up 3 to 25 percent of the map unit.

Permeability is very rapid or rapid in areas of Pits and Dumps, and available water capacity is very low. Organic matter content is very low, and fertility is low. The water level in a pit is generally 5 to 10 feet below that of the soil surface. The mounds of sand are devoid of vegetation during mining operations, but within a year or two after the mining has ceased, sparse vegetation appears. Runoff is very low.

Most of the acreage of this unit is used for commercial mining of sand and gravel. In some areas, commercial mining has stopped and the areas are used for wildlife habitat or recreation.

These areas are not suited to agricultural uses. Native grasses can be grown in these areas if the areas are shaped and the topsoil replaced. A suitable seedbed needs to be prepared. Heavy mulching before seeding helps to protect the seedlings from blowing sand. These areas are best suited to species that can grow in dry sandy soils.

These miscellaneous areas are not suited to trees and shrubs in windbreaks. However, tolerant trees and shrubs can be established if they are hand planted or if special practices are used. Trees require special care after planting if they are to survive. Newly planted trees may need supplemental watering and seedlings need protection from blowing sand. This protection can be provided by a wooden barrier or by maintaining a cover of native grass among the individual trees.

This unit is suited as habitat for wetland wildlife. Some areas can be reshaped and stabilized to make them suited to use as recreation areas. Roads can be constructed for accessibility to the lakes. Picnic areas can be built. The water areas can be developed for fishing and boating. The fine sand material provides ideal beaches for sunbathing and relaxation. Swimming areas can be developed if the mounds of sand are graded back into the lake to reduce depth of the water.

These areas are generally not suited to septic tank absorption fields because of pollution by seepage. If septic tank absorption fields are installed, they need to be constructed on elevated fill to minimize contamination of the ground water. Summer cottages and permanent homes can be constructed around the shorelines of abandoned pits if the locations are carefully selected and protected from flooding. The walls or sides of shallow excavations should be shored to prevent sloughing or caving. Temporary roads can be constructed, but generally the sandy material needs to be stabilized by using gravel or asphalt material in construction.

This map unit is assigned to capability unit VIIIs-8, dryland, and windbreak suitability group 10. It is not assigned to a range site.

Sm—Shell silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on high bottom lands. This soil formed in stratified silty alluvium. It is occasionally flooded. Individual areas of this soil range from 5 acres to several hundred acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 6 inches thick. The subsurface layer is dark grayish brown, very friable silt loam about 14 inches thick. Below this is a layer of grayish brown, friable silt loam about 10 inches thick. The underlying material is pale brown silt loam in the upper part and pale brown, very fine sandy loam in the lower part to a depth of more than 60 inches. In a few small areas, the surface layer is silty clay loam or stratified silt loam and silty clay loam. In a few small areas, the soil is mottled below a depth of 40 inches. Some small areas have fine sand below a depth of 40 inches.

Included with this soil in mapping are small areas of Cass and Hobbs soils. The sandy Cass soils are on low bottom lands and are slightly lower on the landscape than the Shell soil. Hobbs soils have stratified layers above 20 inches and are lower on the landscape. Also included in mapping are areas along the north fork of the Elkhorn River that are subject to rare flooding and are protected by dikes. The included soils make up about 10 to 15 percent of this map unit.

Permeability is moderate in this Shell soil, and the available water capacity is high. Runoff is slow. Organic matter content is moderate, and natural fertility is high. The rate of water intake is moderate. The surface layer is easily tilled throughout a fairly wide range of moisture conditions. This soil releases moisture readily to plants.

Most of the acreage of this soil is cultivated. A few areas are in native grass or are seeded to introduced grass and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, soybeans, grain sorghum, alfalfa, and oats. In some years, flooding delays planting and cultivation of crops. Weed control and maintenance of a high level of fertility are the main concerns of management. Conservation tillage practices, such as discing, chiseling, and no-till planting, help to maintain the tilth and workability of this soil and conserve soil moisture. Applying feedlot manure helps to maintain high fertility.

If irrigated, this soil is suited to both sprinkler and gravity irrigation systems. Under irrigation, this soil is suited to corn, grain sorghum, soybeans, and alfalfa. Land leveling helps to improve surface drainage and increases the efficiency of irrigation systems. Conservation tillage practices, such as discing and chiseling, keep crop residue on the surface and thereby help to conserve soil moisture and maintain high fertility. Flooding needs to be controlled on this occasionally flooded soil.

This soil is suited to introduced grass pastures. Cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, mixed with alfalfa can be grown. This soil is also suited to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water during the dry periods can increase the vigor and growth of introduced grasses.

This soil is suited to rangeland. Overgrazing by livestock and haying at the improper time or by improper methods reduce the protective plant cover and cause deterioration of desired grasses. A planned grazing

system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Healthy seedlings of common species, properly planted in a well prepared site generally survive and grow well. Cultivation between the rows or careful use of herbicides can help to control weeds and undesirable grasses. Newly planted trees may need watering during times of insufficient rainfall.

This soil is not suited to septic tank absorption fields or to dwellings because it is occasionally flooded. A suitable alternate site is needed. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect roads from flood damage.

This soil is assigned to capability units IIw-3, dryland, and IIw-6, irrigated, the Silty Lowland range site, and windbreak suitability group 1.

Sn—Shell silty clay loam, 0 to 1 percent slopes. This deep, well drained, nearly level soil is on high bottom lands. It is subject to occasional flooding. This soil formed in silty sediments over stratified alluvium. Areas range from 15 acres to several hundred acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 19 inches thick. The upper part of the underlying material is dark grayish brown and brown, stratified silty clay loam. The lower part of the underlying material is very dark grayish brown, silty clay loam to a depth of more than 60 inches. Some small areas have layers of silty clay below a depth of 24 inches.

Included with this soil in mapping are small areas of Alcester, Colo, Hobbs, and Muir soils. Alcester soils are not subject to flooding and are higher on the landscape than the Shell soils. Colo soils are somewhat poorly drained and slightly lower on the landscape. The stratified Hobbs soils are lower on the landscape. Muir soils are rarely flooded and are higher on the landscape. The included soils make up 5 to 10 percent of the map unit.

Permeability is moderate in this Shell soil, and the available water capacity is high. The organic matter content is moderate, and natural fertility is high. Runoff is slow. Tilth is fair. Good tillage is possible only within a limited range of soil moisture content. The rate of water intake for irrigation is moderate. Moisture is released readily to plants.

Most of the acreage of this soil is cultivated. Many areas are irrigated. A few small areas are in range or are seeded to introduced grasses.

Under dryland farming, this soil is suited to corn, soybeans, oats, grain sorghum, and alfalfa. In some years, flooding delays planting and cultivation of crops. Diversions help to control flooding. Conservation tillage practices, such as discing or chiseling, keep all or most of the crop residue on the surface and thereby help to conserve moisture for use by crops. A no-till planting system can be used for row crops. Applying feedlot manure helps maintain organic matter content and fertility of the soil.

If irrigated, this soil is suited to both sprinkler and gravity irrigation systems. Corn, grain sorghum, soybeans, and close-grown crops, such as alfalfa, can be grown. Land leveling and installing a tailwater recovery system can increase the efficiency of water use under gravity irrigation. The rate of water application needs to be adjusted so as not to exceed the soil's rate of water intake. Surface drainage and V-shaped drainage ditches help to remove floodwaters. Damage from flooding is generally slight. Conservation tillage practices, such as discing and chiseling, keep crop residue on the surface and thereby help to conserve soil moisture and improve the rate of water intake.

This soil is suited to introduced grass pastures. Cool-season grasses, such as smooth brome, orchardgrass, or tall fescue, can be mixed with alfalfa. This soil is also suited to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Proper stocking and rotational grazing help to keep the desired grasses in good condition. Applying nitrogen fertilizer and irrigation water can increase the vigor and growth of grasses.

This Shell soil is suited to rangeland. Overgrazing, untimely haying, and use of improper mowing heights reduce the protective plant cover and cause deterioration of the native grasses. Proper grazing use, a planned grazing system, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Healthy seedlings of common species, properly planted in a well prepared site, generally survive and grow well. Cultivation between the rows or careful use of appropriate herbicides can help to control weeds and undesirable grasses. Newly planted trees may need watering during times of insufficient rainfall.

This soil is not suited to septic tank absorption fields or to the construction of dwellings because it is occasionally flooded. A suitable alternate site is needed. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help to protect roads from flood damage. Roads need to be designed so that the surface pavement and base are thick enough to compensate for

the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance.

This soil is assigned to capability units IIw-3, dryland, and IIw-3, irrigated, the Silty Lowland range site, and windbreak suitability group 1.

Sv—Shell Variant silty clay loam, 0 to 1 percent slopes. This deep, moderately well drained, nearly level soil is on bottom lands. This soil formed in silty and clayey alluvium, and it is subject to occasional flooding. Individual areas range from 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 6 inches thick. The subsurface layer is also dark grayish brown, friable silty clay loam about 10 inches thick. The subsoil is friable silty clay loam about 12 inches thick. It is grayish brown in the upper part and brown in the lower part. The underlying material is silty clay. It is gray in the upper part and dark gray in the lower part to a depth of more than 60 inches. In some small areas, the silty clay underlying material is below a depth of 40 inches. In other small areas, the underlying material is silty clay loam.

Included with this soil in mapping are small areas of Colo, Hobbs, and Lamo soils. Colo and Lamo soils are somewhat poorly drained and are lower on the landscape than the Shell Variant soil. The stratified Hobbs soils are lower on the landscape. The included soils make up about 3 to 15 percent of this map unit.

Permeability is moderate in the upper part of this Shell soil and slow in the lower part. Available water capacity is high. Organic matter content is moderate, and natural fertility is high. This soil has a perched seasonal high water table that ranges from a depth of 2.5 feet in most wet years to 4 feet in most dry years. The water table occurs mainly in the spring, when rainfall is greatest. Runoff is slow. Tilth is fair. Good tillage is possible only within a limited range of soil moisture content. This soil releases moisture slowly to plants. Its shrink-swell potential is high.

Most of the acreage of this soil is cultivated. A small acreage is in native or introduced grasses and is used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, soybeans, oats, and grain sorghum. Alfalfa can be grown for hay and pasture. Wetness caused by the perched water table is the principal limitation. Surface drainage is needed in places. Diversions help to prevent runoff from higher lying soils. Conservation tillage practices, such as discing, chiseling, or no-till planting, keep crop residue on the surface and thereby help to prevent evaporation of soil moisture and improve tilth.

If irrigated, this soil is suited to both gravity and sprinkler systems. Corn and alfalfa are the main crops grown under irrigation. Surface drainage is needed in some areas. The slow permeability of the clayey material causes the formation of a perched water table, which causes wetness-related difficulties. A small amount of land leveling is generally needed for gravity irrigation. Excessive application of water can result in ponding. Conservation tillage practices, such as discing and chiseling, keep crop residue on the surface, thereby helping to prevent the evaporation of soil moisture and improving the tilth of the soil.

This soil is suited to cool-season grasses for pastures. Smooth brome, orchardgrass, or tall fescue can be mixed with alfalfa. Warm-season grasses can also be grown. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Pastures can also be alternated with row crops as part of the cropping system. Overgrazing reduces the protective plant cover and causes deterioration of the desired grasses. Grazing when the soil is wet causes compaction. Proper stocking and rotational grazing help to keep the grasses in good condition. Irrigated pastures generally respond to nitrogen fertilizer.

This Shell Variant soil is suited to rangeland. Overgrazing by livestock and haying at improper times or by improper methods reduce the protective cover and cause deterioration of desired grasses. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Healthy seedlings of common species, properly planted in a well prepared site generally survive and grow well. Cultivation between the rows or careful use of herbicides can help to control weeds and undesirable grasses. Newly planted trees may need watering during times of insufficient rainfall.

This soil is not suited to septic tank absorption fields or to construction of dwellings because of flooding. A suitable alternate site is needed. Roads need to be designed so that the surface pavement and base are thick enough to compensate for the low strength of the soil material. Using coarse grained material for subgrade or base material can ensure better performance. Installing a gravel moisture barrier in the subgrade, crowning the roadbed by grading, and constructing adequate side ditches can provide needed surface drainage and thus reduce damage by frost action.

This soil is assigned to capability units IIw-2, dryland, and IIw-2, irrigated, the Silty Lowland range site, and windbreak suitability group 1.

ThB—Thurman loamy fine sand, 1 to 3 percent slopes. This deep, somewhat excessively drained, very gently sloping soil is on low ridges and side slopes of sandy uplands. It formed in eolian sand. Individual areas of this soil range from 3 acres to several hundred acres in size.

Typically, the surface soil is very friable loamy fine sand about 14 inches thick. The upper part is dark

grayish brown, and the lower part is very dark grayish brown. The next layer is dark grayish brown, loose loamy fine sand about 4 inches thick. The underlying material is pale brown and brown fine sand to a depth of more than 60 inches. In places, the plowed surface layer is grayish brown fine sand. In some areas, the surface layer is 20 to 26 inches thick. In other areas, the surface layer is 6 to 10 inches thick. Some small areas are gently sloping. In a few small areas, a silty or loamy layer is below a depth of 40 inches.

Included with this soil in mapping are small areas of Boelus, Elsmere, Hadar, and Loretto soils. The Boelus, Hadar, and Loretto soils are well drained and are lower on the landscape than the Thurman soil. The Elsmere soil is somewhat poorly drained and is lower on the landscape. The included soils make up about 10 to 25 percent of this map unit.

Permeability is rapid in this Thurman soil, the available water capacity is low, and the rate of water intake is very high. Runoff is slow. Organic matter content is moderately low, and natural fertility is low. This soil is easily tilled moist or dry. It releases moisture readily to plants.

Most of the acreage of this soil is cultivated, but some areas are in native grass and are used for hay or grazing. Some small areas are in trees and shrubs and are used for field windbreaks.

Under dryland farming, this soil is suited to corn, grain sorghum, rye, and legumes. Low available water capacity is a limitation. Soil blowing is the principal hazard. This hazard can be reduced and moisture can be conserved by use of stripcropping, field windbreaks, and a tillage system that keeps crop residue on the surface. Discing and no-till planting conserve needed moisture. Returning crop residue to the soil and applying feedlot manure help to maintain and improve fertility of the soil.

If irrigated, this soil is suited only to sprinkler irrigation because of its uneven slopes and the very high rate of water intake. This soil is not suited to gravity irrigation. Corn and alfalfa are the main crops grown. Deep cuts during land leveling need to be avoided because of the danger of exposing the underlying material of fine sand. Light, frequent applications of water are needed. Excessive amounts of water leach fertilizers and herbicides below the level of plant roots. A vegetative cover is needed to protect the soil from blowing. Conservation tillage practices, such as chiseling, keep crop residue on the surface and thereby help to prevent soil blowing. Stripcropping and narrow field windbreaks also help to control soil blowing. Applying feedlot manure helps to maintain organic matter content and improve fertility.

This soil is suited to introduced grass pastures. Use of this soil for tame pasture is an effective way to control soil blowing. Cool-season grasses, such as smooth brome and orchardgrass, can be mixed with alfalfa or other legumes. This soil is also suited to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Introduced grasses can be used in alternation with row crops as part of a cropping sequence. Overgrazing reduces the protective cover, causes deterioration of the desired grasses, and can cause severe losses by soil blowing. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water can increase the growth and vigor of grasses.

This soil is suited to native grasses used for range, and using it for rangeland is an effective way to control soil blowing. Overgrazing, haying at improper times, or mowing to improper heights reduces the protective plant cover, causes deterioration of desired grasses, and causes severe losses by soil blowing. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain and improve the range condition. Range seeding may be needed to stabilize severely eroded cropland.

This Thurman soil generally is fairly well suited to trees and shrubs in windbreaks. Inadequate moisture is the main limitation, and soil blowing is the main hazard. Soil blowing can be prevented by maintaining strips of sod or planting a cover crop between the rows. Cultivation should be restricted to the tree rows. Undesirable grasses and weeds in the tree rows can be hoed by hand or appropriate herbicides can be used. Irrigation may be needed in periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. Care needs to be taken to ensure that the seepage does not contaminate the ground water; for example, septic tanks should be placed an adequate distance from wells. This soil is suited to construction of dwellings. The walls or sides of shallow excavations should be temporarily shored to prevent sloughing or caving. This soil is suited to the construction of roads.

This soil is assigned to capability units IIIe-5, dryland, and IIIe-11, irrigated, the Sandy range site, and windbreak suitability group 5.

ThC—Thurman loamy fine sand, 3 to 6 percent slopes. This deep, somewhat excessively drained, gently sloping soil is on low ridges and side slopes of the sandy uplands. It formed in eolian sand. Individual areas of this soil range from 5 to 400 acres in size.

Typically, the surface soil is grayish brown, very friable loamy fine sand about 12 inches thick. The next layer is grayish brown, very friable loamy fine sand about 5 inches thick. The underlying material is fine sand. The upper part is light yellowish brown, and the lower part is very pale brown to a depth of more than 60 inches. In some small areas, the plowed surface layer is grayish brown fine sand. Some small areas are very gently sloping. Other small areas have a surface layer that is 20

to 26 inches thick. In some small areas, the surface layer is 6 to 10 inches thick.

Included with this soil in mapping are small areas of Boelus, Elsmere, Hadar, and Loretto soils. Boelus, Hadar, and Loretto soils are well drained and are lower on the landscape than the Thurman soil. The Elsmere soil is somewhat poorly drained and lower on the landscape. The included soils make up 10 to 30 percent of this map unit.

Permeability of this Thurman soil is rapid, the available water capacity is low, and the rate of water intake is very high. Runoff is slow. Organic matter content is moderately low, and natural fertility is low. This soil is easily tilled moist or dry. It releases moisture readily to plants.

About 60 percent of the acreage of this soil is cultivated. Most of the remaining areas are in native grass and are used for grazing or mowed for hay. Some small areas are in trees and shrubs and are used for field windbreaks.

If this soil is used for dryland farming, it is poorly suited to corn, grain sorghum, small grains, and alfalfa. The principal hazards are soil blowing and droughtiness. Other concerns of management are conserving moisture and maintaining fertility. Soil blowing can be reduced and moisture conserved by the use of stripcropping, field windbreaks, and a cover crop or residue on the soil most of the time. Applying feedlot manure helps to maintain or improve fertility. Discing and no-till planting also help to conserve soil moisture.

If irrigated, this soil is suited to a sprinkler system of irrigation. Corn and alfalfa can be grown. Soil blowing is the main hazard. Low fertility is an important concern of management. Deep cuts during land leveling need to be avoided because of the danger of exposing the underlying material of fine sand. Applications of water should be light and frequent because excessive water leaches fertilizer and herbicides below the level of plant roots. Conservation tillage practices, such as no-till planting, keep crop residues on the surface and thereby help to prevent soil blowing. Stripcropping and narrow field windbreaks also help to control soil blowing. Applying feedlot manure helps to maintain organic matter content and fertility.

This soil is suited to introduced grass pastures, and using it for introduced pasture is an effective way to control soil blowing. Cool-season grasses, such as smooth brome and orchardgrass, can be mixed with alfalfa or other legumes. This soil is also suited to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Introduced grasses can be used as part of a cropping sequence that alternates grasses and row crops. Overgrazing reduces the protective plant cover, causes deterioration of desired grasses, and results in severe losses by soil blowing. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water can increase the growth and vigor of grasses.

This Thurman soil is suited to rangeland and is used for grazing or mowed for hay. Using it for range is an effective way to control soil blowing. Overgrazing, haying at improper times, and mowing to improper heights reduce the protective cover, cause deterioration of desired grasses, and result in severe losses by soil blowing. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the desired plants.

This soil generally is fairly well suited to trees and shrubs in windbreaks. Inadequate moisture is the main limitation, and soil blowing is the main hazard. Soil blowing can be prevented by maintaining strips of sod or planting a cover crop between the rows. Cultivation should be restricted to the tree rows. Undesirable grasses and weeds can be controlled by careful use of selected herbicides within the tree rows. Irrigation water may be needed during periods of low rainfall.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. Care needs to be taken to assure that seepage does not contaminate the ground water. The walls or sides of shallow excavations should be temporarily shored to prevent sloughing or caving. This soil is suited to the construction of dwellings and roads. Small commercial buildings need to be designed to accomodate the slope or the slope can be graded.

This soil is assigned to capability units IVe-5, dryland, and IVe-11, irrigated, the Sandy range site, and windbreak suitability group 5.

ThD—Thurman loamy fine sand, 6 to 11 percent slopes. This deep, somewhat excessively drained, strongly sloping soil is on ridges and side slopes of sandy uplands. It formed in eolian sand. Individual areas range from 3 to 30 acres in size.

Typically, the surface soil is dark grayish brown, very friable loamy fine sand about 13 inches thick. The next layer is grayish brown, very friable loamy fine sand about 6 inches thick. The underlying material is light yellowish brown and very pale brown fine sand to a depth of more than 60 inches. In some small areas, the dark surface layer is 20 to 26 inches thick. In some small areas, the soil is gently sloping. Other small areas have a surface layer 5 to 10 inches thick.

Included with this soil in mapping are small areas of Boelus and Loretto soils. The Boelus and Loretto soils are well drained and lower on the landscape than the Thurman soil. The included soils make up about 5 to 15 percent of this map unit.

Permeability of this Thurman soil is rapid, and the available water capacity is low. The rate of water intake is very high. Runoff is medium. Natural fertility is low, and organic matter content is moderately low. This soil releases moisture readily to plants.

Most of the acreage of this soil is in native grass and is mowed for hay or grazed. Some areas are cultivated and used for irrigated crops.

This soil is not suited to dryland farming because of strong slopes, low available water capacity, and the high risk of soil blowing.

This soil is poorly suited to irrigation. The sprinkler system is the only method that can be used. Under irrigation, this soil is suited to alfalfa. Row crops, such as corn, can be grown if the crop is carefully managed. Soil blowing is the main hazard. Low available water capacity is a limitation. Water should be applied frequently and lightly to prevent the leaching of fertilizers and herbicides below the level of plant roots. Conservation tillage practices, such as no-till planting, keep crop residue on the surface and thereby help to control soil blowing. Stripcropping also helps to prevent soil blowing. Applying nitrogen fertilizer and feedlot manure helps to maintain organic matter content and improve fertility.

Using this soil for introduced grass pastures is an effective way to control soil blowing. This soil is suited to cool-season grasses, such as smooth brome and orchardgrass, mixed with alfalfa, as well as to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used for a long grazing season. Overgrazing reduces the protective cover, causes deterioration of the desired grasses, and can cause losses by soil blowing. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying irrigation water and nitrogen fertilizer can increase the growth and vigor of grasses.

This soil is suited to rangeland, and using it for rangeland is an effective way to control soil blowing. Overgrazing, untimely haying, and use of improper mowing heights reduce the protective plant cover and cause deterioration of the desired grasses. These practices can also cause severe losses by soil blowing and create small blowouts. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the desired native plants.

This Thurman soil is fairly suited to trees and shrubs in farmstead and feedlot windbreaks. Field windbreaks are generally not recommended. Soil blowing is the principal hazard. Trees need to be planted in shallow furrows and should not be cultivated. Sod can be maintained between the tree rows. Undesirable grasses and weeds within the rows can be controlled by careful use of appropriate herbicides, roto-tilling, or hand hoeing.

Septic tank absorption fields can be constructed on the contour after grading. This soil readily absorbs the effluent from septic tank absorption systems, but it does not adequately filter the effluent. Care needs to be taken so that seepage does not contaminate the underground water table. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. Dwellings need to be properly designed to accommodate the slope, or the soil can be graded. Cutting and filling is generally needed to provide a suitable grade for roads and streets.

This soil is assigned to capability units VIe-5, dryland, and IVe-11, irrigated, the Sandy range site, and windbreak suitability group 7.

Tm—Thurman loamy fine sand, thick, 0 to 2 percent slopes. This deep, somewhat excessively drained, nearly level soil is on uplands and stream terraces. The soil formed in eolian sand. Individual areas of this soil range from 3 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, very friable loamy fine sand about 7 inches thick. The subsurface layer is also very dark grayish brown, very friable loamy fine sand about 11 inches thick. The next layer is dark grayish brown, very friable loamy fine sand about 6 inches thick. The underlying material is fine sand to a depth of more than 60 inches. It is brown in the upper part and pale brown in the lower part. In a few small areas, the underlying material is loamy fine sand. In cultivated areas, the plow layer is slightly lighter colored than is typical, or it is fine sand because of winnowing. Also, in a few small areas the surface layer is thinner.

Included with this soil in mapping are small areas of Blendon, Boelus, Elsmere, and Hadar soils. Blendon soils are well drained and are slightly lower on the landscape than the Thurman soil. Boelus and Hadar soils are well drained and are slightly higher on the landscape. The somewhat poorly drained Elsmere soils are lower on the landscape. The included soils make up about 10 to 25 percent of this map unit.

This Thurman soil has rapid permeability and low available water capacity. The rate of water intake is very high, and runoff is slow. The organic matter content is moderately low, and natural fertility is low. The surface layer is easily tilled, moist or dry, and releases moisture readily to plants.

Most of the acreage of this soil is cultivated, but some areas are in native grass and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, grain sorghum, rye, and legumes. Soil blowing is the main hazard. Low available water capacity is a limitation. Conservation tillage practices, such as discing, stubble mulch tillage, and no-till planting, help to prevent soil blowing. Cover crops and field windbreaks are also helpful in preventing soil blowing. Returning crop residue to the soil and applying feedlot manure help to maintain and improve fertility.

If irrigated, this soil is suited to a sprinkler system of irrigation. It is not suited to a gravity system because of the very high rate of water intake. Corn and alfalfa can be grown under irrigation. Deep cuts during land leveling need to be avoided because of the danger of exposing the fine sand underlying material. Light, frequent

applications of water are needed. Excessive amounts of water leach fertilizers and herbicides below the level of plant roots. Soil blowing is a serious hazard if protective cover is not maintained. Conservation tillage practices that keep crop residue on the surface help to prevent soil blowing. Application of feedlot manure helps to maintain organic matter content and fertility.

This soil is suited to introduced grass pastures. Using it for tame pasture is an effective way to control soil blowing. Cool-season grasses, such as smooth brome and orchardgrass, can be mixed with alfalfa or other legumes. This soil is suited to warm-season grasses. Separate pastures of cool-season and warm-season grasses can be used to provide a long grazing season. Introduced grasses can be used as part of a cropping sequence that is alternated with row crops. Overgrazing reduces the protective plant cover and causes deterioration of the desired grasses and can cause severe losses by soil blowing. Proper stocking and rotational grazing help to keep the grasses in good condition. Applying nitrogen fertilizer and irrigation water can increase the vigor and growth of introduced grasses.

This soil is suited to native grass for range. Using it for rangeland is an effective way to control soil blowing. Overgrazing, haying at improper times, or mowing at improper heights reduces the protective cover and causes deterioration of desired grasses. These practices can also cause severe losses by soil blowing and create small blowouts. A planned grazing system, proper grazing use, and timely deferment of grazing or haying help to maintain or improve the native grasses.

This soil generally is fairly well suited to trees. Inadequate moisture is the main limitation, and soil blowing is the main hazard. Soil blowing can be prevented by maintaining strips of sod or by planting a cover crop between the rows. Cultivation should be restricted to the tree rows. Undesirable grasses and weeds within the rows can be controlled by careful use of selected herbicides, roto-tilling, or hand hoeing.

This Thurman soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. Care needs to be taken to ensure that effluent from septic tank absorption fields does not contaminate the underground water table. This soil is suited to the construction of dwellings. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. This soil is suited to the construction of local roads.

This soil is assigned to capability units IIIe-5, dryland, and IIIe-11, irrigated, the Sandy range site, and windbreak suitability group 5.

VaD—Valentine fine sand, 3 to 9 percent slopes. This deep, excessively drained, gently sloping to strongly sloping soil is on uplands. It formed in eolian sand. Individual areas range from 3 acres to several hundred acres in size.

Typically, the surface layer is dark grayish brown, loose fine sand about 6 inches thick. The next layer is brown, loose fine sand about 4 inches thick. The underlying material is pale brown and very pale brown fine sand to a depth of more than 60 inches. In some areas, the soil contains blowouts, and in other small areas, the soil is moderately steep or steep. Some small areas have a surface layer of loamy fine sand that is 10 to 15 inches thick.

Included with this soil in mapping are small areas of Boelus and Elsmere soils. Boelus soils are well drained and are lower on the landscape than the Valentine soil. Elsmere soils are somewhat poorly drained and are in valleys and depressions lower on the landscape. Included soils make up about 10 to 15 percent of this map unit.

Permeability is rapid in this Valentine soil, and the rate of water intake is very high. Available water capacity is low. Runoff is slow. This soil is low in organic matter content, natural fertility, nitrogen, available phosphorus, and calcium.

Most of the acreage of this soil is in native grass and is used for range. A small acreage is irrigated.

This soil is not suited to dryland cultivation because of the sandy texture, low available water capacity, and high risk of soil blowing.

If irrigated, this soil is poorly suited to a sprinkler irrigation system. It is not suited to a gravity system. Under irrigation, this soil is suited to alfalfa, and row crops can be grown if the crop is carefully managed. Soil blowing, low fertility, and the very high rate of water intake are major concerns of management. Light, frequent applications of water help to prevent the leaching of nutrients below the root zone. Conservation tillage practices, such as chiseling or discing, keep crop residue on the surface and help to reduce soil blowing. Stripcropping is also beneficial. Applying feedlot manure helps to improve fertility.

This soil is suited to rangeland, and using this soil for range is an effective way to control soil blowing. Overgrazing by livestock, haying at improper times, and mowing to improper heights reduce the protective plant cover; as a result, desired plants may deteriorate and severe soil losses by soil blowing and small blowouts can occur. A planned grazing system, proper grazing use, and deferment of grazing help to keep the native plants in good condition and control soil blowing.

This Valentine soil generally is fairly suited to trees and shrubs in farmstead and feedlot windbreaks. If used for field windbreaks, this soil provides a fair planting site. Soil blowing is the principal hazard. This soil is best suited to drought-resistant trees. Trees need to be planted in shallow furrows and not cultivated because the soil is sandy. Young seedlings may suffer from sand blasting during high winds and may be covered with drifting sand if not protected.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. Care needs to be taken to assure that seepage does not contaminate the ground water or nearby streams. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving. This soil is suited to construction of dwellings and roads.

This soil is assigned to capability units VIe-5, dryland, and IVe-12, irrigated, the Sands range site, and windbreak suitability group 7.

VaF—Valentine fine sand, 9 to 20 percent slopes. This deep, excessively drained, strongly sloping to steep soil is on uplands. This soil formed in eolian sandy material. Areas range from 3 to 70 acres in size.

Typically, the surface layer is dark grayish brown, loose fine sand about 8 inches thick. The next layer is grayish brown, loose fine sand about 4 inches thick. The underlying material is pale brown fine sand to a depth of more than 60 inches. Some areas of this soil contain small blowouts. Some small areas are gently sloping. A few small areas have a loamy fine sand surface layer that is 10 to 15 inches thick.

Included with this soil in mapping are small areas of Elsmere soils. The somewhat poorly drained Elsmere soils are on valleys and depressions below the Valentine soil. The included soils make up about 5 to 8 percent of this map unit.

Permeability is rapid in the Valentine soil, and the available water capacity is low. Runoff is slow. This soil is low in organic matter content, natural fertility, nitrogen, available phosphorus, and calcium. Moisture is released readily to plants.

Most of the acreage of this soil is in native grass and is used for grazing. A few areas are in introduced grasses or trees.

This soil is not suited to cultivated crops, either dryland or irrigated, because of the uneven steep slopes, the high risk of soil blowing, and droughtiness.

This soil is suited to rangeland. Using this soil for rangeland is an effective way to control soil blowing. Overgrazing by livestock, haying at improper times, and mowing to improper heights can reduce the protective plant cover and cause deterioration of the desired plants. If the protective cover is reduced, severe losses by soil blowing and small blowouts can occur. A planned grazing system, proper grazing use, and timely deferment of grazing help to keep the grasses in good condition.

This soil generally is fairly suited to trees and shrubs in farmstead and feedlot windbreaks. If used for field windbreaks, this soil provides a fair planting site. Soil blowing is the principal hazard. This soil is best suited to the drought-resistant conifers. Seedlings should be planted in shallow furrows and should not be cultivated because the soil is sandy and susceptible to blowing. If not protected, young seedlings may suffer from sand blasting during high winds and may be covered by drifting sand. Wooden barriers can be used to protect the plants.

This soil is not well suited to septic tank absorption fields because of steep slopes. This soil readily absorbs the effluent from septic tank absorption systems, but it does not adequately filter the effluent. Care needs to be taken to assure that seepage does not contaminate the underground water table or nearby streams. The walls or sides of shallow excavations should be temporarily shored to prevent sloughing or caving. Dwellings need to be properly designed to accommodate the slope, or the soil can be graded. Cutting and filling are generally needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIe-5, dryland. It is not assigned to an irrigated capability unit. It is in the Sands range site and windbreak suitability group 7.

Zo—Zook silty clay loam, 0 to 1 percent slopes. This deep, poorly drained, nearly level soil is on bottom lands along major streams. This soil formed in clayey and silty alluvium. This soil is occasionally flooded. Areas range from 3 to 100 acres in size.

Typically, the surface layer is dark gray, friable silty clay loam about 7 inches thick. The subsurface layer is dark gray, friable silty clay loam in about the upper 5 inches; very dark gray, firm silty clay in the middle 8 inches; and dark gray, firm silty clay in the lower 13 inches. The subsoil is gray, firm silty clay about 13 inches thick. The underlying material is gray mottled silty clay to a depth of more than 60 inches thick. Some small areas have a surface layer of silty clay.

Included with this soil in mapping are small areas of Cass, Gibbon, Muir, and Shell soils. Cass soils are well drained and are slightly higher on the landscape than the Zook soil. The somewhat poorly drained Gibbon soils are on the same landscape. The well drained Muir and Shell soils are slightly higher on the landscape. The included soils make up about 5 to 10 percent of this map unit.

Permeability of this Zook soil is slow, the available water capacity is high, and the rate of water intake is very low. Organic matter content is high, and natural fertility is high. This soil has a seasonal high water table that fluctuates from a depth of about 1 foot in most wet years to about 3 feet in most dry years. Runoff is very slow. Tilth is fair. Good tillage is possible only within a limited range of soil moisture content. This soil absorbs moisture slowly and releases it slowly to plants. The shrink-swell potential is high.

Most of the acreage of this soil is used for cultivated crops, but some areas are in grass and are used for grazing or mowed for hay.

Under dryland farming, this soil is suited to corn, grain sorghum, soybeans, and alfalfa. This soil is not well suited to spring-sown small grains because of wetness in early spring. Tillage is commonly delayed in spring because of wetness. If suitable outlets are available, tile

drains can be installed to help control wetness. Shallow surface drains or V-shaped drainage ditches can be constructed to help control soil wetness. Diversion ditches help to control flooding. Conservation tillage practices that keep crop residue on the surface help to improve tilth and increase organic matter content. Soil blowing is a hazard in the winter if this soil is plowed in the fall. Applying feedlot manure helps to maintain fertility.

If irrigated, this soil is suited to both gravity and sprinkler systems of irrigation. Corn, soybeans, grain sorghum, and alfalfa can be grown under irrigation. Soil wetness is the principal limitation. Land leveling may be needed to improve both surface drainage and irrigation efficiency. The proper rate of water application is necessary to keep the crops from drowning, as this soil takes in water at a very slow rate. Applying feedlot manure helps to maintain fertility. Keeping crop residue on the surface by discing or chiseling is preferable to plowing the soil.

This soil is suited to introduced grasses for pasture. It is well suited to cool-season grasses, such as creeping foxtail or reed canarygrass, mixed with alfalfa. It is also well suited to warm-season grasses. Separate pastures of warm-season grasses and cool-season grasses can be used for a long grazing season. Pastures can be used as part of a cropping sequence that includes row crops. Overgrazing, grazing when the soil is wet, or haying at improper times reduces the protective cover and causes deterioration of the desired grasses. Proper stocking and rotational grazing help to keep the desired grasses in good condition. Applying nitrogen fertilizer and irrigation water increases the growth and vigor of pasture grasses.

This soil is suited to native grasses that are used for grazing or haying. Using this soil for rangeland requires proper management of grazing or haying. Overgrazing, untimely haying, and use of improper mowing heights reduce the vegetative cover and cause deterioration of native plants. When the soil is wet, overgrazing can cause surface compaction, making grazing or harvesting of hay difficult. Restriction on use during wet periods and timely deferment of grazing or haying help to maintain the grasses in good condition. Proper grazing use, timely deferment of grazing, and restriction on use during very wet periods help to maintain the grasses in good condition.

This Zook soil is well suited to trees and shrubs in windbreaks. Species selected should be able to tolerate the wetness of this soil. Establishing seedlings can be difficult during wet years. Competition from weeds and grasses is a limitation. Occasional flooding is a hazard. The soil should be tilled and seedlings planted after the soil has begun to dry. Cultivation between the rows is needed to help control weeds and grasses. Proper use of appropriate herbicides and roto-tilling help to control weeds and grasses within the rows.

This soil is not suited to septic tank filter fields because of slow permeability, flooding, and wetness caused by a seasonal high water table. A suitable alternate site is needed. This soil is generally not suited to buildings because of flooding, wetness from a seasonal high water table, and the high shrink-swell potential of the soil. A suitable alternate site is needed. Constructing roads on suitable compacted fill material and providing adequate side ditches and culverts help to protect roads from flood damage. The surface pavement and base need to be thick enough to compensate for the low strength of the soil material. Using coarse grained material for the subgrade or base material can ensure better performance. Providing a gravel moisture barrier in the subgrade, crowning the roadbed by grading, and constructing adequate ditches can ensure good surface drainage and reduce damage by frost action.

This soil is assigned to capability units IIw-4, dryland, and IIw-1, irrigated, the Subirrigated range site, and windbreak suitability group 2W.

Prime Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short- and long-range needs for food and fiber. The supply of high quality farmland is limited, and the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, must encourage and facilitate the use of our nation's prime farmland with wisdom and foresight.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops when it is treated and managed using acceptable farming methods. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland may now be in crops, pasture, woodland, or other land, but not urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It also has favorable temperature and growing season and acceptable acidity or alkalinity. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. For more detailed information on the criteria for prime farmland, consult the local staff of the Soil Conservation Service.

About 169,090 acres, or nearly 46 percent of Madison County, meets the soil requirements for prime farmland.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and difficult to cultivate and are usually less productive.

Soil map units that meet the soil requirements of prime farmland in Madison County are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units."

Soils that have limitations—a high water table, flooding or inadequate rainfall—may qualify as prime farmland if these limitations are overcome by such measures as drainage, flood control, or irrigation. In table 5, the measures used to overcome the limitations, if any, are shown in parentheses after the map unit name. Onsite evaluation is necessary to see if these limitations have been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land use changes.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and sites for windbreaks; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock or wetness can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

William C. Reinsch, conservation agronomist, Soil Conservation Service, prepared this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1974, according to the Nebraska Agriculture Census, 80 percent of the agricultural land in Madison County was planted to crops (*4*). The largest acreage was in corn and soybeans, followed by alfalfa, grain sorghum, and small grains. The potential of the soils in Madison County for increased production of food is good.

Dryland Management

Good management practices on dryfarmed soils are those that reduce runoff and the risk of erosion, conserve moisture, and improve tilth. Most of the soils in Madison County are suited to crop production. In many places, however, the hazard of erosion is severe and the soils need to be protected by suitable conservation practices.

Terraces, contour farming, grassed waterways, and conservation tillage systems that keep crop residue on the surface help to reduce water erosion, increase intake rates, reduce water runoff, and increase the amount of moisture available for crops (fig. 12). Keeping crop residue on the surface or growing a protective plant cover reduces sealing and crusting of the soil during and after heavy rains. In winter, stubble catches drifting snow that can provide additional moisture.

Soil blowing is a major hazard in the part of Madison County where Thurman loamy fine sand and Valentine fine sand occur. The same management practices that control water erosion can control soil blowing. Examples of these practices are crop residue management, conservation tillage practices, contour stripcropping, and planting narrow field windbreaks. The overall hazard of erosion can be reduced if areas of the more productive soils are used for row crops and the steeper, more erodible soils are used for close-grown crops, such as small grains, alfalfa, or grasses for hay and pasture. Proper use of the land alone can reduce the hazard of erosion in many places.

Figure 12.—Newly constructed terraces on an area of the Nora-Crofton complex.

The sequence of crops grown on a field, in combination with the practices needed for the management and conservation of the soil, is known as a conservation cropping system. Under dryland farming, the management practices and cropping systems should preserve soil tilth and fertility; maintain plant cover that protects the soil from erosion; and control weeds, insects, and diseases. Cropping systems vary according to the soils on which they are used. For example, the crop sequence on Crofton-Nora complex, 11 to 15 percent slopes, eroded, should include a high percentage of grass and legume crops to control erosion and maintain tilth and fertility. However, on Belfore silty clay loam, 0 to 2 percent slopes, the crop sequence can include a higher percentage of row crops.

The best management practices for cultivated fields to protect the soil and reduce erosion on Class I soils, such as Belfore, on Class IIw soils, such as Colo silty clay loam, and on Class IIIw soils, such as Elsmere loamy fine sand, are proper use of crop residue, addition of nutrients in fertilizers or feedlot manure, and good agronomic practices. On Class IIe soils, such as Moody silty clay loam, 2 to 6 percent slopes, the best practices are those that allow crop residue to remain on the soil over winter, contour farming, grassed waterways, and a conservation tillage system that leaves 40 percent of the surface covered with crop residue after the crops are planted. On Class IIIe and IVe soils the best practices are those that leave the standing crop residue on the soil over winter, contour farming, terraces, grassed waterways, and a conservation tillage system that leaves 40 percent of corn residue, sorghum residue, or small grain residue on the soil surface after planting the crop. On soils that have slopes of 11 to 15 percent, grasses and legumes are needed in the cropping sequence along with terraces, grassed waterways, and a conservation tillage system for row crops that leaves more than 40 percent of crop residue on the surface after planting to reduce water erosion to an acceptable level.

Tillage is necessary to prepare a seedbed, to control weeds, and to provide a favorable place for plants to grow. Excessive tillage, however, breaks down the granular structure in the surface layer that is needed for good soil tilth. Steps in the tillage process should be limited to those that are essential. Various conservation tillage practices can be used in Madison County (fig. 13). The no-till, till-plant, and disc or chisel and plant are practices well suited to row crops. Grasses can be established by drilling into a cover of stubble without further seedbed preparation.

All soils that are used for cultivated crops or for pasture should be tested to determine their need for additional nutrients. Under dryland farming, the kind and amount of fertilizer to be applied should be based on the

results of soil tests and on the moisture content of the soil at the time when fertilizer is applied. If the subsoil is dry or rainfall is below normal, the amount of nitrogen fertilizer applied should be slightly less than the recommended amount. Nitrogen fertilizer benefits nonlegume crops on all soils. Phosphorus and zinc are needed on the more eroded soils and in cut areas after construction of terraces or diversions.

Dryland soils require smaller amounts of fertilizer than irrigated soils because the plant population is generally lower. Some soils in Madison County are somewhat poorly drained because they have a moderately high water table. Open drainage ditches and underground tile systems can be used to help lower the water table if suitable outlets at low elevations can be found. Where the water table cannot be lowered sufficiently for good crop growth, crops can be planted that are tolerant to wet conditions.

Herbicides can be used to control weeds. Care needs to be taken to apply the correct kind of herbicide at the proper rate to correspond with the soil conditions. Most of the chemical activity of the soil takes place in the colloidal clay and humus fraction of the soil. Therefore, crop damage from herbicides is more likely to occur on the coarse and moderately coarse soils that are low in colloidal clay and in areas where the organic matter content is moderately low or low. The rate of herbicide application needs to be correspondingly lower on these soils. Herbicides should be applied in accordance with instructions on the label. Keeping field boundaries on the contour helps provide for uniformity of soils in a field, thereby lessening the danger of any damage from herbicides.

Irrigation Management

According to the Nebraska Agricultural Statistics, in 1979 about 23 percent of all cropland in Madison County was irrigated. About 90 percent of the irrigated cropland was in corn. A smaller acreage was in soybeans and alfalfa (*5*).

Both the sprinkler and furrow systems are suited to corn and soybeans. Alfalfa can be irrigated by the border, the contour ditch, the corrugation, or the sprinkler system.

The methods of irrigation most commonly used in Madison County are the sprinkler, furrow, and border systems. Furrow and border irrigation are also known as "gravity systems," as they are used on sloping soils and make use of the slope.

Two general kinds of sprinkler irrigation are in use. In one kind, perforated pipe is placed in a location, left until a specified amount of water has been applied, and then

Figure 13.—Conservation tillage helps to control erosion and runoff on areas of the Nora-Crofton-Moody association.

moved to another area. In the self-propelled center-pivot system, an elevated irrigation pipe revolves on a center pivot and the apparatus is slowly moved across the field.

If a sprinkler irrigation system is used on soils such as Moody silty clay loam, 2 to 6 percent slopes, and Nora silty clay loam, 6 to 11 percent slopes, the same conservation practices that control water erosion on dryland crops should be applied. Terraces, contour farming, and conservation tillage practices that leave a protective cover of crop residue on the soil after the row crop is planted protect the soil from erosion and help to conserve the supply of irrigation water by reducing evaporation and increasing the soil's intake of rainfall.

If the sprinkler irrigation method is used, water should be applied at a rate that allows the soil to absorb the water and keeps runoff to an allowable level. Sprinklers can be used on the more sloping soils as well as on the nearly level ones. Some coarse textured soils, such as Thurman loamy fine sand, 3 to 6 percent slopes, are suited to sprinkler irrigation if conservation practices are applied that control soil blowing. Because the water can be controlled, sprinklers have special use in conservation; for example, in establishing grass stands, reducing soil blowing, and improving seed germination of most crops. In summer much water is lost through evaporation, and because of wind drift, water is applied unevenly under some sprinkler irrigation systems. Watering at night when wind velocities and temperatures are lowest reduces evaporation and improves distribution of water.

In the furrow method of irrigation, water flows by gravity from a main ditch and down a series of furrows that run between rows of crops. This method is generally used on soils that have slope of 2 percent or less. Soils having greater slope, such as Moody silty clay loam, 2 to 6 percent slopes, are subject to erosion if they are irrigated by furrows that are constructed up and down the slope. To reduce erosion, these soils should be contour bench leveled or irrigated by contour furrows in combination with parallel terraces. If either of these methods is used, crop residue should be maintained on the surface of the soil. Contour farming is also helpful. Land leveling increases the efficiency of furrow irrigation by permitting an even distribution of water.

The border irrigation system is used on gentle slopes. Narrow strips of land are leveled across a slope, and low ridges, or borders, are built around each strip. The areas are then flooded.

A tailwater recovery pit can be installed at the end of a field irrigated by the furrow or border system to trap the excess irrigation water. This water can be pumped to the upper end of the field and used again. This practice increases the efficiency of the irrigation system and helps conserve the supply of underground water.

Mostly row crops are grown on soils that are well suited to irrigation. Rotation of the crop from corn to soybeans or to alfalfa and grass helps to control the plant diseases and insects that are a common result of growing the same crop year after year.

Conservation practices for irrigated soils vary according to the type of irrigation used. On soils irrigated by a sprinkler system, erosion can be controlled by maintaining grassed waterways and by using a conservation tillage system that keeps crop residue on the surface. Soils irrigated by a furrow or border system should be contour bench leveled or irrigated with contour furrows in combination with parallel terraces. In addition, sufficient residue should be maintained on the soil's surface to keep erosion to tolerable levels.

Because soil holds a limited amount of water, irrigation is needed at regular intervals to keep the soil moist. The interval between applications varies according to the crop, the soil, and the amount of moisture in the soil. The water should be applied only as fast as the soil can absorb it.

Irrigated silty soils in Madison County hold about 2 inches of available water per foot of soil depth. A soil that is 4 feet deep and planted to a crop that sends its roots to a depth of 4 feet can hold about 8 inches of available water for the crop.

For maximum efficiency, irrigation should be started when about one-half of the stored water has been used by the plants. If a soil can hold 8 inches of available water, irrigation should be started when about 4 inches has been removed by the crop. Irrigation should be planned to replace water at a rate that will provide a stable water supply for the crop.

Irrigated soils generally produce higher yields than dryfarmed soils. Consequently, more plant nutrients, particularly nitrogen and phosphorus, are removed in harvested crops. Returning all crop residue to the soil and adding feedlot manure and commercial fertilizer help to maintain the needed plant nutrients. Most grain crops in Madison County respond to nitrogen fertilizer. Soils disturbed during land leveling, particularly if the topsoil has been removed, respond to phosphorus, zinc, and iron. The kinds and amounts of fertilizer needed for specific crops should be determined by soil tests.

The soils in Madison County that are suited to irrigation are assigned to an irrigation design group. These design groups are described in the Nebraska Irrigation Guide (*10*), which is part of the technical specifications for conservation in Nebraska.

Assistance in planning and designing an irrigation system is available through the local office of the Soil Conservation Service or the county agricultural agent.

Pasture and Hayland Management

Areas that are in hay or pasture should be managed for maximum production. Once the pasture is established the grasses need to be kept productive. A planned system of grazing that meets the needs of the plants and promotes uniform forage use is important if high

returns are expected. Most forage plants are a good source of minerals, vitamins, proteins, and other nutrients. A well managed pasture can provide a balanced diet for livestock throughout the growing season.

A mixture of adapted grasses and legumes can be grown on many kinds of soils, and if properly managed, the soil can return a fair profit. Grasses and legumes are compatible with grain crops in a crop rotation and have beneficial effects on soil building. Because grasses and legumes help to improve tilth, add organic matter, and reduce erosion, they are an ideal crop for use in a conservation cropping system.

Grasses and legumes that are used for pasture and hayland, either irrigated or nonirrigated, require additional plant nutrients in order to reach maximum vigor and growth. The kinds and amounts of fertilizer needed should be determined by a soil test. The most commonly grown grasses for irrigated pastures are smooth brome and orchardgrass. Other grasses and legumes that are adapted to irrigation in Madison County are intermediate wheatgrass, meadow brome, and creeping foxtail. Legumes that have potential for irrigated or nonirrigated pastures are birdsfoot trefoil and cicer milkvetch.

Irrigated pastures in Madison County can produce 750 to 900 pounds of beef per acre under a high level of management. Irrigated pastures are an economic alternative in choosing a resource management system for irrigated croplands. Converting cropland to irrigated pastureland also helps to control erosion.

Grasses that have potential for use as pasture without irrigation are smooth brome, intermediate wheatgrass, meadow brome, tall fescue, and orchardgrass. Some native warm-season grasses, planted as a single species on nonirrigated land, can be used in conjunction with cool-season pastures to improve forage quality during the grazing season. Switchgrass, indiangrass, and big bluestem are native warm-season grasses that can be used in a planned system of grazing to provide high quality forage during the summer months.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIIw-5.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Prepared by Peter N. Jensen, range conservationist, Soil Conservation Service.

Rangeland acreage makes up about 10 percent of the total agricultural land in Madison County. Most rangeland is in the sandhills of the Thurman-Valentine soil association and is in the parts of the Ord-Inavale-Boel soil association where the water table is high. The majority of the rangeland is in the Sands, Limy Upland, Wet Land, and Subirrigated range sites. The rest is in the Silty, Clayey, Sandy, Sandy Lowland, Thin Loess, Silty Overflow, Clayey Overflow, and Silty Lowland sites. The average size of livestock farms or ranches is about 480 acres.

The raising of livestock, mainly cow and calf herds, and the selling of calves in the fall as feeders is the second largest agricultural industry in the county. Cattle generally graze the rangeland from late spring through early fall. In early spring they graze smooth brome, and in the late fall and early winter they graze corn or grain sorghum (milo). They are fed silage or silage and alfalfa or native hay for the rest of the winter.

In some parts of Madison County, the rangeland has been depleted by overuse. Currently, approximately 65 percent of the rangeland produces less than one-half of its potential in kinds and amounts of native plants. The overused pastures support low forage-producing grasses and broadleaf weeds. The productivity of the range can be increased by using sound management practices; namely, proper grazing use, rest or deferment of grazing, and planned grazing systems. In addition, range seeding may be needed on cropland where soil losses exceed tolerable limits.

At the end of each map unit description, the soil or soils in that unit are assigned to an appropriate range site according to the kind or amount of vegetation that is grown on the soil when the site is in excellent or climax condition. The interpretations for each range site in the county are in the Technical Guide, which is in the local office of the Soil Conservation Service. Livestock producers or other users who want technical help with programs to improve rangeland or grass seeding can obtain help from the local office of the Soil Conservation Service.

Native Woodland

Prepared by Keith A. Ticknor, forester, Soil Conservation Service.

Madison County has approximately 3,900 acres of woodland, mostly along the major streams of Union Creek, Battle Creek, and Shell Creek, and along the Elkhorn River and in many of the upland drainageways.

Trees and shrubs in the drainageways of the major streams consist primarily of eastern cottonwood, green ash, boxelder, black willow, American elm, Siberian elm, common hackberry, American plum, and common chokecherry. Most of the existing sawtimber in the county is along these drainageways, and approximately 75 percent of it is eastern cottonwood.

The upland drainageways support most of the species found along the major streams, as well as eastern redcedar, honeylocust, bur oak, smooth sumac, catalpa, and Russian mulberry.

Many of the trees, especially eastern cottonwood, green ash, common hackberry, and bur oak, have commercial value for wood products. However, very few wooded areas are managed for commercial production. Most of the wooded areas are in private ownership and make up only a small acreage of the farm unit.

Since 1955, the woodland acreage in Madison County has declined by approximately 50 percent. Most of this decline has occurred as the result of clearing the woodland and converting it to cropland.

Bottom land soils along the drainageways have good potential for production of sawtimber, firewood, Christmas trees, and other wood products, but most of these soils are used as cropland and are unlikely to be converted to production of wood products. Odd areas or small, hard-to-farm fields are good sites for woodland.

Windbreaks and Environmental Plantings

Prepared by Keith A. Ticknor, forester, Soil Conservation Service.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Most farmsteads in Madison County have windbreaks that have been planted at various times by the landowners. Siberian elm and eastern cottonwood are the most common tree species, especially in the older windbreaks. Some other species that are common around the farmsteads are eastern redcedar, honeylocust, green ash, Russian-olive, ponderosa pine, Austrian pine, and Scotch pine.

Tree planting around the farmstead is a continuing process. Old trees pass maturity and deteriorate, some trees are lost to insect and disease attacks, others are destroyed by storms, and new windbreaks are needed for expanding farmsteads.

Field windbreaks or shelterbelts are numerous in Madison County, especially in areas of the Thurman-Loretto-Boelus soil association (fig. 14). Many of these field windbreaks consist of eight to ten rows of trees and shrubs. In addition, there are some younger plantings of one-row or two-row field windbreaks. The common species in the old plantings are Siberian peashrub, American plum, eastern cottonwood, honeylocust, green ash, Siberian elm, Russian-olive, Russian mulberry, northern catalpa, eastern redcedar, and ponderosa pine.

Many of the old field windbreaks have passed maturity and are deteriorating. Renovation practices of thinning, removal, and replanting are needed to maintain the value and effectiveness of these windbreaks.

In order for windbreaks to fulfill their intended purpose, the trees or shrubs selected must be suited to the soils in the area to be planted. Matching the proper trees with the soil type is the first step toward ensuring survival and growth in the windbreak. Permeability, available water capacity, and fertility are soil characteristics that greatly affect the rate of growth for trees and shrubs in windbreaks.

Generally, trees and shrubs can be easily established in Madison County, but controlling the competition from weeds and grasses after planting is an important concern in es'ablishing and managing windbreaks.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Recreation

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

In a 1967 study on outdoor recreation in Madison County (*9*), the survey area was rated as having medium potential for vacation cabins, campgrounds, picnic and sports areas, fishing, golf courses, hunting, natural scenic and historic areas, shooting preserves, and vacation farms. It was rated as having low potential for riding stables and water sports areas.

Several public recreation facilities are maintained by the Nebraska Game & Parks Commission in Madison County. The Yellowbanks Wildlife Management Area covers 259 acres; 254 acres of land and 5 acres of water. The Area has limited access for small boats, and hunting for waterfowl, upland game, and deer is permitted during regular controlled seasons. In the Oak Valley Wildlife Management Area, 480 acres are available for hunting during regular seasons and for hiking, birdwatching, and photography. The Millstone State Wayside Area offers 4 acres with minimum basic facilities for picnicking and camping. The Elkhorn State Wayside Area has 44 acres and is open to picnicking and camping. Skyview Lake, a watershed structure operated by the Lower Elkhorn Natural Resources District on the edge of the city of Norfolk, attracts approximately 25,000 visitors a year to Norfolk and the surrounding territory. Picnicking, swimming, fishing, and boating are the most popular attractions (fig. 15).

Other outdoor recreation opportunities in Madison County include a gun club, an archery club, golfing, and auto racing.

Hunting for dove, pheasant, bobwhite quail, and deer is common on private lands throughout the county during regular hunting seasons. Opportunities for catfish, bass,

Figure 14.—Field windbreaks protect cropland from wind erosion in this area of the Thurman-Loretto-Boelus association.

and bluegill fishing are available on farm ponds and on the Elkhorn River.

Madison County offers a wide variety of scenic attractions. The hills and valleys and many trees, shrubs, and vines on roadsides and in fencerows offer scenic beauty.

Technical assistance is available for designing installations to improve habitat for wildlife, as well as facilities for recreation within Madison County. The Soil Conservation Service has a field office in Madison and can provide this assistance, or they can direct you to an agency that can provide the needed assistance.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to

Figure 15.—Skyview Lake provides recreation facilities and flood control.

flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that

limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, ash, willow, and Russian mulberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, honeysuckle, and Peking cotoneaster.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, prairie cordgrass, rushes, sedges, and reedgrass.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include cottontail, quail, woodcock, opossum, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and coyote.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Kinds of Wildlife by Soil Association

The following paragraphs discuss the nine soil associations in Madison County in relation to their use as wildlife habitat.

The Nora-Crofton-Moody and the Belfore-Moody-Nora associations have a nearly level to steep topography and some brushy draws. The drainageways support redcedar, green ash, elm, native plum, chokecherry, Virginia creeper, native rose, smooth sumac, hackberry, cottonwood, and bur oak. The farmstead shelterbelts also have caragana, honeylocust, Russian-olive, ponderosa pine, Austrian pine, and Scotch pine. The more level areas are commonly farmed. The main crops are corn, soybeans, and alfalfa. Irrigation is common where water is available. These two associations offer habitat diversity for wildlife in the form of food, cover, and water. Long field windbreaks have been planted to control wind erosion and to provide wildlife habitat.

The Thurman-Loretto-Boelus and the Thurman-Hadar-Blendon associations offer openland wildlife habitat for such wildlife species as bobwhite quail, pheasant, and cottontail rabbit (fig. 16). The topography is mostly undulating and dissected by drainageways. Cottonwood and willow trees grow in areas where the water table is near the surface. The drier parts of the drainageways

Figure 16.—Shrubs provide cover and food for wildlife in an area of the Thurman-Loretto-Boelus association.

contain native grasses, such as big bluestem, little bluestem, switchgrass, indiangrass, and sideoats grama; and trees, shrubs, and vines, such as native rose, chokecherry, ash, elm, redcedar, hackberry, catalpa, honeylocust, Virginia creeper, and wild grape. Trees and shrubs along fence rows and around farmsteads also provide winter food and cover for wildlife.

The Thurman-Valentine association provides rangeland habitat for prairie grouse, whitetailed deer, badger, coyote, and fox. The most common grasses are big bluestem, little bluestem, prairie sandreed, switchgrass, indiangrass, sideoats grama, and blue grama. In roadside ditches, woody and grassland vegetation intermingle.

The Muir-Shell-Hobbs association provides excellent habitat along and adjacent to the main streams of the county—the Elkhorn River, Union Creek, and Shell Creek. The high diversity of cover types includes native rangeland and pastureland and many areas of excellent cultivated cropland, both irrigated and nonirrigated. Woody species, such as cottonwood, boxelder, willow, green ash, hackberry, elm, chokecherry, and native plum, are common. Dead trees serve as den trees for raccoon, squirrel, and woodpecker and as perches for predatory hawks, owls, eagles, and nongame birds.

The Ord-Inavale-Boel, the Gibbon-Lamo-Ord, and the Elsmere-Thurman associations are on bottom lands and stream terraces of the Elkhorn Valley and provide the greatest diversity of cover types for wildlife in the county. Russian-olive, chokecherry, mulberry, hackberry, and honeysuckle grow along roadsides and in drainageways. Wetland wildlife, such as mink, muskrat, and beaver are common, as are waterfowl and shore birds (fig. 17). Whitetailed deer and upland game birds, such as pheasant and bobwhite quail, find cover along the stream and food on the adjacent bottom lands. The riparian habitat offers cover for squirrel, cottontail rabbit, and songbirds. Birds of prey, such as hawks, owls, and

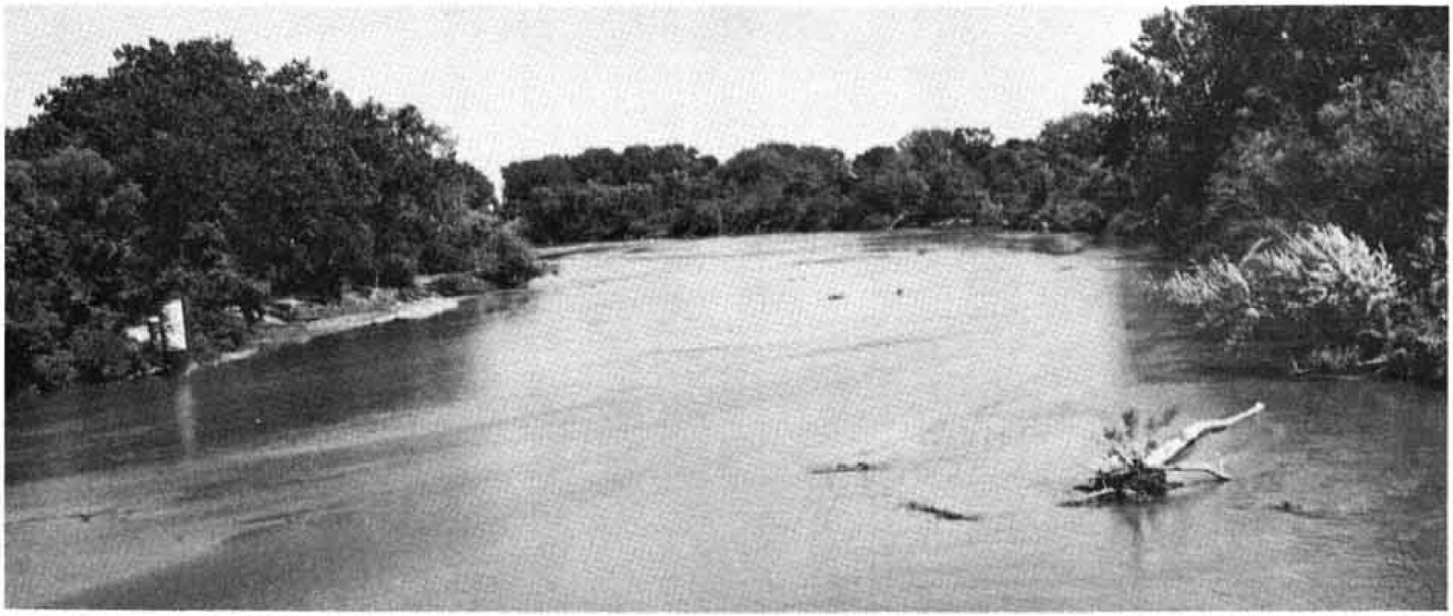

Figure 17.—The Elkhorn River is used for wildlife habitat and recreation.

eagles, use the larger trees for nests and perches. Raccoon, squirrel, and woodpecker make homes in the den trees. Some long field windbreaks are in these soil associations. The predominant tree species in the windbreaks are green ash, honeylocust, cottonwood, willow, Russian-olive, elm, redcedar, and pine.

Throughout Madison County, winter cover and nesting cover are the elements most needed for a more abundant wildlife population.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and

topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on soil properties, site

features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of

excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment

can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 18.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 18.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69.

The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

In table 17, some soils are assigned to two hydrologic groups. Soils that have a seasonal high water table but can be drained are assigned first to a hydrologic group that denotes the drained condition and then to a hydrologic group that denotes the undrained condition; for example, B/D. Because there are different degrees of drainage and water table control, onsite investigation is needed to determine the hydrologic group of the soil in a particular location.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that

flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

Samples from soil profiles were collected for mechanical and chemical analysis by the National Soil Survey Laboratory, Soil Conservation Service, in Lincoln, Nebraska. A pedon of a Belfore soil was sampled in Madison County. Pedons of Crofton, Nora, Moody, and Thurman soils were sampled in nearby counties. These data are recorded in Soil Survey Investigations Report Number 5 (*8*).

This information is useful to soil scientists in classifying soils and in developing concepts of soil genesis. It is also helpful in estimating available water capacity, susceptibility to wind erosion, fertility, degree of tilth, and other aspects of the soil that influence soil management.

Engineering Index Test Data

Table 18 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil Series and Their Morphology." The soil samples were tested by the Nebraska Department of Roads.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Particle density (T-100-75I) (AASHTO). The group index number that is part of the AASHTO classification is computed by using the Nebraska Modification system.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*11*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 19 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittently dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustolls (*Hapl*, meaning minimal horizonation, plus *ustoll*, the suborder of the Mollisols that have a ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Udic*, for example, identifies the subgroup that has a greater supply of moisture than typical. An example is Udic Haplustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Udic Haplustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*7*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*11*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Alcester Series

The Alcester series consists of deep, well drained soils on foot slopes between loessial uplands and along intermittent drainageways in the uplands. Permeability is moderate. These soils formed in silty colluvium. Slopes range from 2 to 6 percent.

Alcester soils are near Hobbs, Muir, Nora, and Shell soils. Hobbs soils are occasionally flooded, do not have a cumulic horizon, and are lower on the landscape. Muir soils are on stream terraces lower on the landscape. Nora soils have a thinner mollic epipedon, have lime

higher in the profile, and are on higher landscapes. Shell soils are occasionally flooded, have stratified layers below a depth of 20 inches, and are lower on the landscape.

Typical pedon of Alcester silty clay loam, 2 to 6 percent slopes, 250 feet north and 2,300 feet west of the southeast corner of section 9, T. 21 N., R. 4 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A—7 to 18 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; neutral; clear wavy boundary.

Bw—18 to 34 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable; neutral; gradual wavy boundary.

BC—34 to 48 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; soft, friable; neutral; clear smooth boundary.

C—48 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates are 36 to 60 inches. The mollic epipedon is typically 34 inches thick, but it ranges from 24 to 50 inches in thickness and extends into the upper part of the B horizon.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically silty clay loam, but it ranges to include silt loam. Reaction ranges from medium acid through neutral.

The B horizon has value of 4 or 5 (2 through 4 moist) and chroma of 1 through 3 (dry or moist). Texture is typically silty clay loam, but in some pedons it is silt loam. Reaction is slightly acid or neutral.

The C horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3 (dry or moist). Texture is typically silt loam, but in some pedons it is silty clay loam. Reaction is mildly alkaline or moderately alkaline.

Bazile Series

The Bazile series consists of deep, well drained soils on uplands. Permeability is moderately slow in the upper part of the profile and rapid in the lower part. These soils formed in loess over eolian sand or sandy outwash material. Slopes range from 2 to 6 percent.

Bazile soils are near Loretto, Nora, and Thurman soils on the landscape. Loretto soils do not have sand above a depth of 40 inches, have less clay in the B horizon, and are slightly higher in elevation. Nora soils do not have sand below a depth of 40 inches, have more clay in the surface layer, and are slightly higher on the landscape. Thurman soils are somewhat excessively drained, have more sand in the 10-to-40-inch control section, and are slightly higher on the landscape.

Typical pedon of Bazile loam, 2 to 6 percent slopes, 2,400 feet north and 450 feet east of the southwest corner of section 11, T. 23 N., R. 3 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A—7 to 11 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium and moderate fine subangular blocky structure; slightly hard, friable; slightly acid; clear wavy boundary.

Bt—11 to 24 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, firm; slightly acid; abrupt smooth boundary.

2C1—24 to 32 inches; pale brown (10YR 6/3) loamy fine sand, yellowish brown (10YR 5/4) moist; single grain; loose; slightly acid; gradual wavy boundary.

2C2—32 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grain; loose; neutral.

The thickness of the solum and the depth to sand range from 20 to 40 inches. The mollic epipedon ranges from 7 to 20 inches in thickness. Free carbonates are not present above a depth of 60 inches.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 2 (dry or moist). Reaction is medium acid or slightly acid. Texture is typically loam or fine sandy loam.

The B horizon has a value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3 (dry or moist). Texture is typically silty clay loam, but the range includes silt loam and clay loam. Reaction ranges from slightly acid through mildly alkaline.

The 2C horizon has value of 6 through 8 (5 or 6 moist) and chroma of 2 through 4 (dry or moist). Texture is loamy fine sand, fine sand, or sand. Reaction ranges from slightly acid through mildly alkaline.

Belfore Series

The Belfore series consists of deep, well drained soils that have moderately slow permeability. These soils formed in loess on broad upland ridgetops. Slopes range from 0 to 2 percent.

Belfore soils are near Crofton, Fillmore, Moody, and Nora soils. Crofton soils do not have a mollic epipedon

or a B horizon, have free carbonates at a depth of less than 8 inches, and are lower on the landscape. Fillmore soils are poorly drained, have more clay in the 10-to-40-inch control section, and are in shallow depressions slightly lower on the landscape. Moody soils have less clay in the B horizon and are on a similar landscape. Nora soils have free carbonates at a depth of less than 30 inches, have less clay in the B horizon, and are lower on the landscape.

Typical pedon of Belfore silty clay loam, 0 to 2 percent slopes, 125 feet south and 1,580 feet west of the northeast corner of section 29, T. 21 N., R. 1 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A—7 to 13 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable; slightly acid; clear smooth boundary.

Bt1—13 to 19 inches; brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate medium and fine subangular blocky structure; hard, firm; neutral; clear smooth boundary.

Bt2—19 to 25 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; neutral; clear wavy boundary.

Bt3—25 to 40 inches; yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, firm; neutral; clear wavy boundary.

BC—40 to 48 inches; light olive brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) moist; few fine distinct reddish brown (5YR 4/3 moist) mottles; weak coarse prismatic structure; soft, firm; neutral; clear smooth boundary.

C—48 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; few fine distinct reddish brown (5YR 5/3 moist) mottles; weak coarse prismatic structure; soft, friable; neutral.

The thickness of the solum ranges from 35 to 54 inches. Thickness of the mollic epipedon ranges from 10 to 20 inches. Carbonates are leached to a depth of 60 inches or more.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Reaction is slightly acid or medium acid. The Bt1 and Bt2 horizons have value of 4 through 6 (3 through 5 moist) and chroma of 2 or 3 (dry or moist). Texture is typically silty clay, but it ranges to include silty clay loam. Clay content averages between 37 and 43 percent. Reaction is slightly acid or neutral.

The Bt3 and BC horizons have value of 4 through 6 (3 through 5 moist) and chroma of 3 or 4 (dry or moist). Texture is typically silty clay loam, but it ranges to include silt loam. Reaction is slightly acid or neutral.

The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 through 4 (dry or moist). Texture is typically silt loam, but it includes silty clay loam. Reaction is slightly acid or neutral.

Blendon Series

The Blendon series consists of deep, well drained soils on stream terraces. Permeability is moderately rapid over rapid. These soils formed in mixed eolian sands and alluvium. Slopes range from 0 to 2 percent.

Blendon soils are near Boelus, Loretto, Ortello, and Thurman soils on the landscape. Boelus and Loretto soils have finer textured B and C horizons and are higher on the landscape. Ortello soils do not have a pachic horizon and are slightly higher on the landscape. Thurman soils have more sand in the 10-to-40-inch control section, are somewhat excessively drained, and are on similar landscapes.

Typical pedon of Blendon fine sandy loam, 0 to 2 percent slopes, 210 feet west and 1,580 feet north of the southeast corner, section 2, T. 24 N., R. 1 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, very friable; medium acid; abrupt smooth boundary.

Bw—10 to 28 inches; very dark gray (10YR 3/1) fine sandy loam, black (10YR 2/1) moist; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, very friable; slightly acid; gradual wavy boundary.

BC—28 to 38 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable; neutral; clear smooth boundary.

C—38 to 60 inches; pale brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) moist; single grain; loose; neutral.

The thickness of the solum ranges from 30 to 40 inches. Thickness of the mollic epipedon is 24 to 40 inches. Carbonates typically are below a depth of 60 inches.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically fine sandy loam, but the range includes sandy loam and loam. Reaction ranges from medium acid through neutral.

The Bw horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Reaction is slightly acid or neutral.

Value of the BC horizon is 4 or 5 (2 or 3 moist) and chroma of 2 or 3 (dry or moist). Reaction is slightly acid or neutral. Some profiles do not have a BC horizon.

The C horizon has value of 5 or 6 (3 or 4 moist) and chroma of 2 through 4 (dry or moist). Texture is typically loamy fine sand, but in some pedons it is fine sand. Reaction is neutral or mildly alkaline.

Boel Series

The Boel series consists of deep, somewhat poorly drained, rapidly permeable soils on bottom lands of major streams. These soils formed in sandy alluvium. Slopes range from 0 to 2 percent.

Boel soils are near Cass, Gibbon, Inavale, and Ord soils on the landscape. Cass soils are well drained and are slightly higher on the landscape. Gibbon soils are finer textured in the control section, are calcareous at or near the surface, and are slightly higher on the landscape. Inavale soils are somewhat excessively drained, do not have a mollic epipedon, and are slightly higher on the landscape. Ord soils have fine sand deeper in the profile and are slightly higher on the landscape.

Typical pedon of Boel fine sandy loam, 0 to 2 percent slopes, 650 feet south and 650 feet west of the northeast corner of section 22, T. 24 N., R. 4 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A—6 to 11 inches; dark gray (10YR 4/2) fine sandy loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, very friable; slightly acid; clear smooth boundary.

AC—11 to 15 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; soft, very friable; neutral; abrupt smooth boundary.

C1—15 to 28 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; neutral; gradual wavy boundary.

C2—28 to 48 inches; light gray (10YR 7/2) and grayish brown (10YR 5/2) fine sand, grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) moist; many fine and medium distinct reddish brown (5YR 4/4 moist) mottles; thin strata of loamy fine sand; single grain; loose; neutral; gradual wavy boundary.

C3—48 to 60 inches; white (10YR 8/2) fine sand, light brownish gray (10YR 6/2) moist; single grain; loose; mildly alkaline.

The thickness of the solum ranges from 10 to 20 inches and is commonly the same thickness as the mollic epipedon.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). It is typically fine sandy loam, but the range includes loam, sandy loam, loamy fine sand, and loamy sand. Reaction ranges from slightly acid through moderately alkaline.

The AC horizon has a value of 3 through 5 (2 or 3 moist) and chroma of 2 (dry or moist). Texture is typically fine sandy loam, but in some pedons, it is loamy fine sand. Reaction ranges from slightly acid through moderately alkaline.

The C horizon has value of 6 through 8 (5 through 7 moist) and chroma of 2 or 3 (dry or moist). Texture is typically fine sand and ranges from loamy fine sand to sand. The C horizon is stratified with thin layers of material that is slightly finer in texture. Reaction ranges from neutral through moderately alkaline.

Boelus Series

The Boelus series consists of deep, well drained soils on uplands. These soils are rapidly permeable in the upper part and moderately permeable in the lower part. They formed in a thin layer of eolian sand and the underlying loess (fig. 18). Slopes range from 2 to 6 percent.

Boelus soils are near Loretto, Nora, and Thurman soils on the landscape. Loretto soils have less sand in the A horizon and are on the same landscape. Nora soils have more clay in the A and B horizons and are slightly lower on the landscape. Thurman soils have more sand in the lower part of the profile, are somewhat excessively drained, and are higher on the landscape.

Typical pedon of Boelus loamy fine sand, 2 to 6 percent slopes, 1,400 feet west and 900 feet south of the center of section 35, T. 23 N., R. 1 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) loamy fine sand, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A—7 to 14 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

BA—14 to 24 inches; grayish brown (10YR 5/2) loamy fine sand, brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable; neutral; abrupt smooth boundary.

2Bw—24 to 38 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable; neutral; clear wavy boundary.

2BC—38 to 50 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; weak medium prismatic structure; slightly hard, friable; mildly alkaline; gradual wavy boundary.

2C—50 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, friable; few fine distinct iron stains; mildly alkaline.

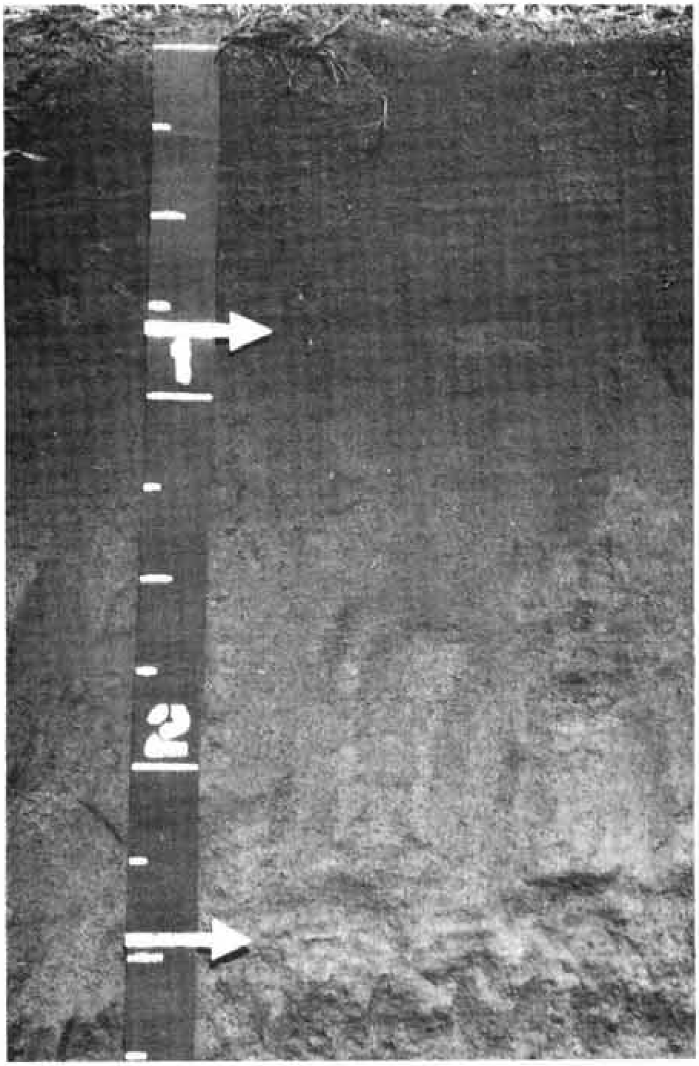

Figure 18.—Profile of Boelus loamy fine sand. Typically, this deep, well drained soil consists of wind-deposited loamy fine sand in the upper part, and loess in the lower part. Depth is marked in feet.

The thickness of the solum ranges from 30 to 55 inches. The mollic epipedon ranges from 10 to 20 inches in thickness. Depth to the 2B horizon ranges from 20 to 36 inches. Depth to free carbonates ranges from 50 inches to more than 60 inches.

The A horizon has a value of 3 through 5 (2 through 4 moist) and chroma of 1 through 3 (dry or moist). Texture is typically loamy fine sand, but the range includes loamy sand and fine sand. Reaction ranges from medium acid through neutral.

The 2B horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4 (dry or moist). Texture is typically silty clay loam, but it includes silt loam and loam. The clay content ranges from 18 to 35 percent. Reaction ranges from slightly acid to mildly alkaline.

The 2C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4 (dry or moist). Reaction is neutral or mildly alkaline.

Cass Series

The Cass series consists of deep, well drained, moderately rapidly permeable soils on the bottom lands of the Elkhorn River. These soils formed in stratified loamy and sandy alluvium. Slopes range from 0 to 2 percent.

Cass soils are near Blendon, Boel, Inavale, Ord, and Shell soils on the landscape. Blendon soils have a mollic epipedon thicker than 20 inches, are not stratified in the C horizon, and are higher on the landscape. Boel soils are somewhat poorly drained, have a sandy control section between 10 and 40 inches, and are lower on the landscape. Inavale soils are somewhat excessively drained, do not have a mollic surface horizon, have a sandy control section, and are on similar landscapes. Shell soils have more clay throughout the profile and are on similar landscapes. Ord soils are somewhat poorly drained and are lower on the landscape.

Typical pedon of Cass fine sandy loam, 0 to 2 percent slopes, 1,740 feet east and 790 feet south of the northwest corner of section 31, T. 24 N., R. 1 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A—6 to 19 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak medium and fine granular structure; slightly hard, very friable; neutral; clear wavy boundary.

AC—19 to 28 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; soft, very friable; neutral; clear wavy boundary.

C1—28 to 45 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; neutral; gradual wavy boundary.

C2—45 to 48 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; neutral; abrupt smooth boundary.

C3—48 to 60 inches; light gray (10YR 7/2) fine sand, grayish brown (10YR 5/2) moist; single grain; loose; neutral; slight effervescence.

The thickness of the mollic epipedon ranges from 10 to 20 inches. Thickness of the solum ranges from 20 to 40 inches. Free carbonates typically are not above a depth of 60 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically fine

sandy loam or loam, but the range includes silt loam or very fine sandy loam. Reaction is slightly acid or neutral.

The AC horizon has value of 5 or 6 (3 or 4 moist) and chroma of 2 or 3 (dry or moist). Texture is typically fine sandy loam, but the range includes sandy loam or very fine sandy loam. Reaction is slightly acid or neutral.

The C horizon has value of 5 through 7 (3 or 4 moist) and chroma of 2 or 3 (dry or moist). Texture is typically loamy fine sand in the upper part and fine sand in the lower part. Thin strata of finer textured material are common. Reaction is neutral to mildly alkaline.

Clarno Series

The Clarno series consists of deep, well drained soils on uplands. These soils formed in glacial till. They have moderately slow permeability. Slopes range from 2 to 6 percent.

Clarno soils are near Hadar, Lawet, and Thurman soils on the landscape. Hadar soils are coarse textured in the upper part of the control section and are slightly higher on the landscape. Lawet soils are poorly drained, have a thicker mollic horizon, and are lower on the landscape. Thurman soils are somewhat excessively drained, do not have a B horizon, have a sandy control section, and are higher on the landscape.

Typical pedon of Clarno loam, 2 to 6 percent slopes, 250 feet west and 2,500 feet north of the southeast corner of section 14, T. 24 N., R. 1 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium to fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A—7 to 12 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; neutral; clear wavy boundary.

Bw—12 to 23 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular; hard, firm; mildly alkaline; clear wavy boundary.

BCk—23 to 36 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; many medium distinct light olive brown (2.5Y 5/6 moist) mottles; weak coarse prismatic structure; hard, firm; violent effervescence; moderately alkaline; gradual wavy boundary.

Ck—36 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; many medium distinct yellowish brown (10YR 5/6 moist) mottles; massive; slightly hard, friable; violent effervescence; many common accumulations of lime; few iron and manganese accumulations; strongly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The mollic epipedon ranges from 8 to 16 inches in thickness. Depth to lime ranges from 12 to 26 inches.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically loam, but the range includes silt loam. Reaction is neutral or slightly acid.

The Bw horizon has value of 4 or 5 (2 through 4 moist) and chroma of 2 or 3 (dry or moist). Texture is typically clay loam, but the range includes loam. The amount of clay ranges from 25 to 34 percent. Reaction is neutral or mildly alkaline.

The BCk and Ck horizons have hue of 10YR through 5Y, value of 5 through 7 (5 or 6 moist), and chroma of 2 through 4 (dry or moist). Reaction is moderately alkaline or strongly alkaline.

Colo Series

The Colo series consists of deep, somewhat poorly drained soils on bottom lands of major creeks. Permeability is moderately slow. These soils formed in noncalcareous, silty alluvium. Slopes range from 0 to 1 percent.

Colo soils are near Hobbs, Lamo, and Shell soils on the landscape. Hobbs soils are well drained, have a thinner A horizon, are stratified, and are slightly higher on the landscape. Lamo soils have free carbonates throughout the profile and are on about the same landscape. Shell soils have a thinner A horizon, are well drained, and are higher on the landscape.

Typical pedon of Colo silty clay loam, 0 to 1 percent slopes, 275 feet east and 150 feet north of the southwest corner of section 33, T. 21 N., R. 2 W.

A1—0 to 8 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

A2—8 to 20 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; weak medium subangular blocky structure; hard, firm; slightly acid; clear wavy boundary.

A3—20 to 36 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak coarse prismatic parting to weak medium subangular blocky structure; hard, firm; neutral; clear smooth boundary.

AC—36 to 44 inches; dark gray (10YR 4/1) silty clay loam, dark gray (10YR 3/1) moist; massive; hard, firm; neutral; gradual wavy boundary.

Cg—44 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few, common distinct olive yellow (2.5Y 6/6 moist) mottles; massive; hard, firm; neutral.

Thickness of the solum and the mollic epipedon ranges from 36 to 50 inches. Most pedons do not have

free carbonates throughout the profile. Some pedons have a stratified, silty, calcareous overwash 6 to 18 inches thick.

The A horizon has value ranging from 3 to 5 (2 or 3 moist) and chroma of 0 or 1 (dry or moist).

Some pedons have a weak structural B horizon.

The C horizon has value of 5 through 7 (3 through 5 moist) and chroma of 0 or 1 (dry or moist). Texture is typically silty clay loam, but in some pedons it ranges to silt loam or loam below a depth of 48 inches.

Crofton Series

The Crofton series consists of deep, well drained to excessively drained, moderately permeable soils on uplands. These soils formed in calcareous loess. Slopes range from 2 to 60 percent.

Crofton soils are near Moody and Nora soils. Moody soils have a mollic epipedon, are more strongly developed, and are on ridgetops and side slopes higher on the landscape. Nora soils have a mollic epipedon, are more strongly developed, and are on similar landscapes.

Typical pedon of Crofton silt loam, 15 to 30 percent slopes, 100 feet north and 400 feet east of southwest corner of section 4, T. 24 N., R. 4 W.

A—0 to 5 inches; grayish brown (10YR 5/2) silt loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

AC—5 to 10 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, very friable; violent effervescence; moderately alkaline; clear wavy boundary.

C1—10 to 25 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; few fine reddish brown (5YR 5/3 moist) mottles; weak coarse prismatic structure; slightly hard, friable; few fine lime concretions; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—25 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam, light olive brown (2.5Y 5/4) moist; few fine reddish brown (5YR 5/3 moist) mottles; massive; slightly hard, friable; few small lime concretions; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 3 to 15 inches, and the depth to free carbonates ranges from 0 to 8 inches. Reaction is mildly or moderately alkaline throughout the profile.

The A horizon has value of 4 through 6 (3 or 4 moist) and chroma of 2 or 3 (dry or moist). The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3 (dry or moist). Some pedons have no AC horizon.

The C horizon has hue of 10YR or 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4 (dry or moist). Most pedons contain relict mottles that have value ranging from 5 through 7 (4 through 6 moist) and chroma of 1 through 6 (dry or moist).

Elsmere Series

The Elsmere series consists of deep, somewhat poorly drained, rapidly permeable soils. These soils formed in eolian sands on bottom lands and low stream terraces and in depressional valleys of the uplands. Slopes range from 0 to 2 percent.

Elsmere soils are near Lawet, Libory, Loup, Ovina, and Thurman soils on the landscape. Lawet soils have more clay and silt in the control section, are poorly drained, and are generally lower on the landscape. Libory soils are moderately well drained, have more clay in the control section, and are higher on the landscape. Loup soils are poorly drained and are lower on the landscape. Ovina soils have less sand in the control section and are on the same landscape. Thurman soils are somewhat excessively drained and are higher on the landscape.

Typical pedon of Elsmere loamy fine sand, 0 to 2 percent slopes, 2,500 feet south and 100 feet west of the northeast corner of section 11, T. 24 N., R. 3 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A—8 to 16 inches; dark gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; slightly acid; clear wavy boundary.

AC—16 to 23 inches, grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; slightly acid; clear wavy boundary.

C1—23 to 40 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; many medium distinct yellowish brown (10YR 5/6 moist) mottles; single grain; loose; slightly acid; gradual wavy boundary.

C2—40 to 60 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; common fine distinct yellowish brown (10YR 5/4 moist) mottles; single grain; loose; slightly acid.

The thickness of the solum ranges from 16 to 36 inches. Thickness of the mollic epipedon ranges from 10 to 20 inches.

Texture of the A horizon is most commonly loamy fine sand, but it ranges to include fine sandy loam, loamy sand, and fine sand. The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Reaction ranges from slightly acid to mildly alkaline.

The AC horizon has value of 5 or 6 (3 or 4 moist) and chroma of 1 or 2 (dry or moist). Texture is typically fine

sand, but in some pedons it is loamy sand. Reaction is slightly acid or neutral.

The C horizon has value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3 (dry or moist). Reaction ranges from medium acid to neutral. Texture of the C horizon is commonly fine sand, but it ranges to include loamy fine sand and loamy sand.

Fillmore Series

The Fillmore series consists of deep, poorly drained soils in depressions on uplands and stream terraces. Permeability is very slow. These soils formed in loess. Slopes range from 0 to 1 percent.

Fillmore soils are near Belfore and Moody soils. Belfore soils have less clay in the Bt horizon, do not have an E horizon, and are higher on the landscape. Moody soils do not have an E horizon, have less clay in the control section, and are higher on the landscape.

Typical pedon of Fillmore silt loam, 0 to 1 percent slopes, 2,500 feet south and 250 feet east of the northwest corner of section 20, T. 21 N., R. 1 W.

Ap—0 to 8 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, very friable; medium acid; abrupt smooth boundary.

E—8 to 15 inches; gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; weak fine platy structure; slightly hard, very friable; medium acid; abrupt smooth boundary.

Bt1—15 to 29 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; weak coarse blocky structure; very hard, firm; few dark shot-like accumulations (iron oxides, manganese oxides, or both); neutral; clear smooth boundary.

Bt2—29 to 44 inches; dark gray (10YR 4/1) silty clay, black (10YR 2/1) moist; weak coarse prismatic structure parting to moderate medium blocky; very hard, firm; neutral; diffuse smooth boundary.

BC—44 to 52 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; weak coarse subangular blocky structure; hard, firm; neutral; diffuse smooth boundary.

C—52 to 60 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; few medium faint yellowish brown (10YR 5/6 moist) mottles; massive; slightly hard, friable; neutral.

Thickness of the solum ranges from 36 to 60 inches. The mollic epipedon is 7 to 17 inches thick.

The A1 horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Reaction is medium acid or slightly acid. Texture is typically silt loam, but in some pedons it is silty clay loam.

The E horizon has value of 5 or 6 (4 or 5 moist) and chroma of 1 (dry or moist). Reaction is medium acid or slightly acid.

The Bt horizon has value of 3 through 5 (2 through 4 moist) and chroma of 1 or 2 (dry or moist). Texture is typically silty clay, but the range includes silty clay loam and clay. Reaction ranges from medium acid through mildly alkaline.

The BC horizon has value of 5 or 6 (3 through 5 moist) and chroma of 2 or 3 (dry or moist). Reaction ranges from medium acid through mildly alkaline.

The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4 (dry or moist). Texture is typically silty clay loam, but in some pedons it is silt loam. Reaction ranges from neutral through moderately alkaline.

Gayville Series

The Gayville series consists of deep, somewhat poorly drained soils on bottom lands. These soils formed in silty and loamy alluvium that is high in exchangeable sodium. Permeability is very slow. Slopes range from 0 to 2 percent.

The Gayville soils in this survey area are a taxadjunct to the Gayville series because they do not have the salt at shallow depths that is defined for the Gayville series. This difference does not change the use or behavior of the soils.

Gayville soils are near Gibbon, Lamo, and Ord soils on the landscape. Gibbon soils do not have a natric horizon, have less clay in the control section, and are on the same landscape. Lamo soils do not have a natric horizon, have less clay in the control section, and are on the same landscape. Ord soils do not have a natric horizon, have more sand and less clay in the control section, and are on the same landscape.

Typical pedon of Gayville soil in an area of Gibbon-Gayville silty clay loams, 0 to 1 percent slopes, 500 feet west and 1,500 feet north of the southeast corner of section 29, T. 24 N., R. 1 W.

E—0 to 1 inch; gray (10YR 6/1) silty clay loam, dark gray (10YR 4/1) moist; weak fine platy structure; soft, very friable; mildly alkaline; abrupt smooth boundary.

Btn1—1 to 10 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; strong effervescence; strongly alkaline, gradual smooth boundary.

Btn2—10 to 17 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; strong medium subangular blocky structure; very hard, firm; strong effervescence; very strongly alkaline; gradual smooth boundary.

BCn—17 to 29 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard,

firm; strong effervescence; strongly alkaline; gradual smooth boundary.

C1—29 to 42 inches; grayish brown (2.5Y 5/2) silt loam, olive gray (5Y 4/1) moist; few medium distinct yellowish brown (10YR 5/4 moist) mottles; thin very dark grayish brown (2.5Y 3/2) strata; massive; slightly hard, firm; violent effervescence; strongly alkaline; gradual smooth boundary.

C2—42 to 60 inches; gray (5Y 6/1) silty clay loam, dark gray (5Y 4/1) moist; few fine faint yellowish brown (I0YR 5/6) mottles; massive; hard, firm; violent effervescence; strongly alkaline.

The thickness of the solum ranges from 10 to 30 inches. Depth to carbonates ranges from 0 to 10 inches.

The E horizon has value of 5 through 7 (3 through 5 moist) and chroma of 1 (dry or moist). Texture is typically silty clay loam, and reaction ranges from mildly alkaline to strongly alkaline.

The Btn horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is silty clay loam or clay that averages between 35 and 45 percent clay. Reaction ranges from moderately alkaline through very strongly alkaline.

The BCn horizon has value of 5 through 7 (3 through 5 moist) and chroma of 2 through 4 (dry or moist). Texture is typically clay loam, but it ranges to include silty clay loam. Reaction ranges from moderately alkaline through very strongly alkaline.

The C horizon has hue of 2.5Y or 5Y, value of 5 through 8 (3 through 5 moist), and chroma of 1 through 4 (dry or moist). It is silt loam or silty clay loam that has thin strata of fine sandy loam and sandy loam. Reaction ranges from moderately alkaline through very strongly alkaline.

Gibbon Series

The Gibbon series consists of deep, somewhat poorly drained, moderately permeable soils on bottom lands of major stream valleys. These soils formed in stratified, calcareous alluvium. Slopes range from 0 to 1 percent.

Gibbon soils are near Boel, Cass, Gayville, Lamo, and Ord soils on the landscape. Boel soils have fine sand between depths of 10 and 20 inches and are lower on the landscape. Cass soils are well drained, have more sand in the control section, and are higher on the landscape. Gayville soils have a natric horizon, have more clay in the control section, and are on the same landscape. Lamo soils have a mollic epipedon thicker than 20 inches. Ord soils have fine sand between depths of 20 and 40 inches. Lamo and Ord soils are on similar landscapes.

Typical pedon of Gibbon silty clay loam, 0 to 1 percent slopes, 800 feet south and 200 feet west of the northeast corner of section 36, T. 24 N., R. 4 W.

A—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; weak fine granular structure; slightly hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

AC—10 to 19 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak fine granular structure; slightly hard, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

Cg—19 to 27 inches; light gray (5Y 6/1) silt loam, gray (5Y 5/1) moist; massive; slightly hard, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

Ck—27 to 42 inches; light gray (5Y 6/1) silt loam, gray (5Y 5/1) moist; few medium faint dark brown (7.5YR 4/4 moist) mottles; massive; slightly hard, very friable; small, common masses of carbonates; strong effervescence; moderately alkaline; abrupt smooth boundary.

C—42 to 60 inches; gray (5Y 6/1) fine sandy loam, olive gray (5Y 5/2) moist; few medium faint reddish brown (5YR 5/4 moist) mottles; massive; soft, very friable; few thin strata of loamy fine sand; moderately alkaline.

The thickness of the solum ranges from 15 to 28 inches. The mollic epipedon ranges from 10 to 20 inches in thickness. Depth to carbonates is less than 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 3 through 5 (2 or 3 moist), and chroma of 1 or 2. Texture is typically silty clay loam, but it includes silt loam and loam. Reaction is mildly alkaline or moderately alkaline.

The C horizon has hue of 10YR to 5Y, value of 5 through 8 (4 through 6 moist), and chroma of 1 or 2. Texture is typically silt loam or loam in the upper part and commonly becomes coarser below a depth of 40 inches. Reaction is moderately alkaline or strongly alkaline.

Hadar Series

The Hadar series consists of deep, well drained soils on uplands. These soils are rapidly permeable in the upper part and moderately slowly permeable in the lower part. They formed in a thin layer of eolian sand and in the underlying glacial till. Slopes range from 2 to 6 percent.

Hadar soils are near Clarno and Thurman soils on the landscape. Clarno soils have finer textured A and B horizons and are below Hadar soils. Thurman soils are somewhat excessively drained, do not have 2B and 2C horizons, have a sandy control section, and generally are above Hadar soils.

Typical pedon of Hadar loamy fine sand, 2 to 6 percent slopes, 150 feet east and 1,800 feet south of the northwest corner of section 13, T. 24 N., R. 1 W.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak very fine granular structure; soft, very friable; medium acid; abrupt smooth boundary.

A—4 to 14 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable; medium acid; clear smooth boundary.

BA—14 to 24 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; medium acid; gradual wavy boundary.

2Bw—24 to 36 inches; light yellowish brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; few fine distinct yellowish brown (10YR 5/8 moist) mottles; moderate medium and fine subangular blocky structure; slightly hard, firm; few pebbles; neutral; gradual wavy boundary.

2C1—36 to 55 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; few fine distinct yellowish brown (10YR 5/6 moist) mottles; weak medium prismatic structure; slightly hard, firm; few pebbles; common seams and pockets of lime; few iron and manganese accummulations; violent effervescence; mildly alkaline; abrupt smooth boundary.

2C2—55 to 60 inches; gray (5Y 5/2) clay loam, olive gray (5Y 4/2) moist; few fine distinct yellowish brown (10YR 5/8 moist) mottles; massive; slightly hard, friable; few stones; common seams and pockets of lime; few iron and manganese accumulations; violent effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. Depth to the 2B horizon is 20 to 36 inches. Depth to free carbonates ranges from 20 to 36 inches.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically loamy fine sand, but the range includes loamy sand or sand. Reaction is slightly acid or medium acid.

The BA horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 through 4 (dry or moist). It is slightly acid or medium acid. Texture is typically loamy fine sand, but it ranges to include loamy sand.

The 2Bw horizon has hue of 10YR or 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4 (dry or moist). Reaction is neutral through moderately alkaline.

The 2C horizon has hue of 2.5Y or 5Y, value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4 (dry or moist). Reaction is mildly alkaline or moderately alkaline.

Hobbs Series

The Hobbs series consists of deep, well drained, moderately permeable soils. These soils formed in stratified, noncalcareous, silty alluvium on bottom lands of narrow upland drainageways (fig. 19). Slopes range from 0 to 2 percent.

Hobbs soils are near Alcester, Colo, Muir, Nora, and Shell soils. Alcester soils have a B horizon, are not stratified, and are on foot slopes higher on the landscape. Colo soils are somewhat poorly drained, have a cumulic horizon, and are on a similar landscape. Muir soils have a B horizon, are not stratified, and are on stream terraces higher on the landscape. Nora soils have a B horizon, are not stratified, and formed in loess on uplands. Shell soils are stratified between depths of 20 and 40 inches and are on similar landscapes.

Typical pedon of Hobbs silt loam, 0 to 2 percent slopes, 125 feet south and 2,590 feet west of the northeast corner of section 21, T. 21 N., R. 3 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

C1—8 to 28 inches; stratified grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) silt loam, very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) moist; weak medium and fine laminated bedding planes; slightly hard, very friable; neutral; abrupt smooth boundary.

C2—28 to 40 inches; brown (10YR 5/3) and pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) moist; weak fine laminated bedding planes; slightly hard, very friable; mildly alkaline; clear wavy boundary.

Ab—40 to 60 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; slightly acid.

Thickness of the solum is less than 10 inches. Carbonates are not present above a depth of 40 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically silt loam, but it ranges to include silty clay loam. Reaction is neutral or mildly alkaline.

The C horizon has value of 4 through 7 (3 through 6 moist) and chroma of 1 through 3 (dry or moist). Thin strata that have higher or lower value are apparent in undisturbed areas. Reaction ranges from slightly acid through mildly alkaline.

Inavale Series

The Inavale series consists of deep, somewhat excessively drained, rapidly permeable soils on bottom

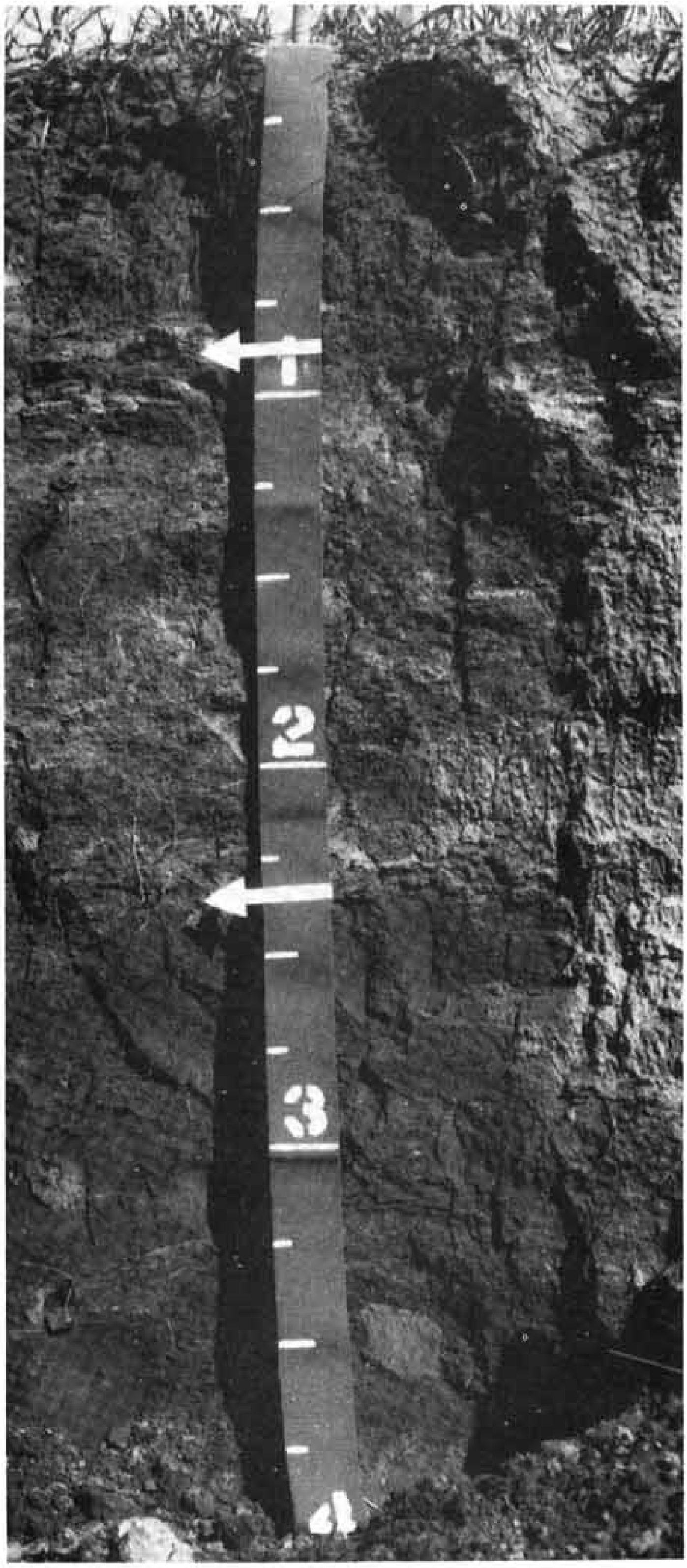

Figure 19.—Profile of Hobbs silt loam. This stratified soil formed in recently deposited alluvium. Depth is marked in feet.

lands of the major stream valleys. These soils formed in recent sandy alluvium. Slopes range from 0 to 6 percent.

Inavale soils are near Boel, Cass, and Ord soils on the landscape. Boel soils have a mollic epipedon, are somewhat poorly drained, and are lower on the landscape. Cass soils are well drained, have a mollic epipedon, and are higher on the landscape. Ord soils are somewhat poorly drained, have a mollic epipedon, and are lower on the landscape.

Typical pedon of Inavale loamy fine sand, 0 to 3 percent slopes, 2,500 feet north and 600 feet east of the southwest corner of section 7, T. 24 N., R. 4 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) loamy fine sand, very dark gray (10YR 3/1) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

AC—7 to 15 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; slightly acid; gradual wavy boundary.

C1—15 to 38 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose; neutral; clear wavy boundary.

C2—38 to 46 inches; pale brown (10YR 6/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium fragments; soft, very friable; neutral; clear wavy boundary.

C3—46 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grain; loose; mildly alkaline.

The thickness of the solum is 10 to 30 inches. Typically, no carbonates are present above a depth of 60 inches.

The A horizon has value of 4 through 7 (3 through 5 moist) and chroma of 1 through 3 (dry or moist), but it does not have a mollic epipedon. Texture is typically loamy fine sand, but the range includes fine sandy loam, fine sand, and sand. Reaction ranges from slightly acid through mildly alkaline.

The AC and C horizons have value of 5 through 7 (4 through 6 moist) and chroma of 2 or 3 (dry or moist). Texture of the AC horizon is typically loamy fine sand, but the range includes fine sand. Texture of the C horizon is typically fine sand, but it ranges to include loamy sand and sand. Thin strata of finer textured material are common in the C horizon. Reaction ranges from neutral through moderately alkaline.

Lamo Series

The Lamo series consists of deep, somewhat poorly drained and poorly drained soils on bottom lands. Permeability is moderately slow and moderate. These soils formed in silty calcareous alluvium. Slopes range from 0 to 1 percent.

Lamo soils are near Colo, Lawet, Ord, and Shell soils on the landscape. Colo soils do not have carbonates and are on the same landscape. Lawet soils have more sand in the 10- to 40-inch control section and are slightly lower on the landscape. Ord soils have more sand in the control section, do not have a cumulic horizon, and are on the same landscape. Shell soils are well drained, do not have carbonates, and are higher on the landscape.

Typical pedon of Lamo silty clay loam, 0 to 1 percent slopes, 50 feet east and 250 feet south of the northwest corner of section 29, T. 24 N., R. 1 W.

A1—0 to 11 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate medium and fine granular structure; slightly hard, friable; strong effervescence; mildly alkaline; clear wavy boundary.

A2—11 to 20 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; moderate medium granular structure; slightly hard, firm; strong effervescence; mildly alkaline; abrupt smooth boundary.

AC—20 to 32 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure parting to moderate medium granular; hard, firm; violent effervescence; moderately alkaline; clear wavy boundary.

C—32 to 52 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 5/2) moist; few fine distinct reddish brown (5YR 4/4 moist) mottles; moderate medium and fine subangular blocky structure; very hard, firm; common medium lime concretions; violent effervescence; moderately alkaline; clear wavy boundary.

Ab—52 to 60 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; massive; very hard, firm; violent effervescence; moderately alkaline.

The thickness of the solum and mollic epipedon ranges from 24 to 39 inches. Depth to carbonates ranges from 0 to 10 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2. Texture is typically silty clay loam, but small areas of silt loam are included.

The AC horizon has hue of 10YR and 2.5Y, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. The control section is typically silty clay loam that averages between 28 and 35 percent clay.

The C horizon has hue of 10YR and 2.5Y, value of 5 through 7 (3 through 6 moist), and chroma of 1 or 2. Texture is typically silty clay loam, but it includes silt loam. Fine sandy loam, loamy fine sand, and fine sand are below a depth of 40 inches in some places.

Lawet Series

The Lawet series consists of deep, poorly drained soils on bottom lands. Permeability is moderate. These soils formed in calcareous, loamy alluvium. Slopes range from 0 to 1 percent.

The Lawet soils in the survey area are a taxadjunct to the Lawet series because they have a thicker mollic epipedon than is definitive for the Lawet series. This difference does not alter the use or behavior of the soils.

Lawet soils are near Elsmere, Lamo wet, Loup, and Ord soils on the landscape. Elsmere and Ord soils are somewhat poorly drained, have more sand in the control section, and are slightly higher on the landscape. Lamo wet soils have less sand and more clay in the control section and are on about the same landscape. Loup soils have more sand in the control section and are on about the same landscape.

Typical pedon of Lawet loam, 0 to 1 percent slopes, 1,300 feet west and 750 feet south of the northeast corner of section 13, T. 22 N., R. 1 W.

Ak1—0 to 10 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak medium and fine granular structure; slightly hard, very friable; violent effervescence; moderately alkaline; clear smooth boundary.

Ak2—10 to 26 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, very friable; violent effervescence; moderately alkaline; gradual smooth boundary.

Bw—26 to 36 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate medium and fine granular structure; slightly hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

Cg1—36 to 46 inches; gray (5Y 5/1) sandy clay loam, dark gray (5Y 4/1) moist; massive; slightly hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.

Cg2—46 to 60 inches; light gray (5Y 6/1) fine sandy loam, olive gray (5Y 5/2) moist; massive; slightly hard, very friable; violent effervescence; moderately alkaline.

The mollic epipedon ranges from 24 to more than 60 inches in thickness. The solum is 24 to 40 inches thick. Free carbonates are throughout the solum.

The Ak horizon has hue of 10YR and 2.5Y, value of 3 through 5 (2 or 3 moist), and chroma of 0 or 1 (dry or moist). Texture is typically loam, but it includes silt loam. Reaction is mildly alkaline or moderately alkaline.

The Bw horizon has hue of 10YR and 2.5Y, value of 3 through 5 (2 or 3 moist), and chroma of 0 or 1 (dry or moist). Texture is typically loam, but it includes silt loam

and sandy clay loam. Reaction is mildly alkaline or moderately alkaline.

The Cg horizon has hue of 10YR, 2.5Y, and 5Y, value of 5 through 7 (4 through 7 moist), and chroma of 0 through 2 (dry or moist). Texture is typically sandy clay loam in the upper part and fine sandy loam in the lower part, and it includes loam and very fine sandy loam. Some pedons have layers of loamy fine sand below 40 inches. Reaction is mildly alkaline or moderately alkaline.

Libory Series

The Libory series consists of deep, moderately well drained soils on uplands. Permeability is rapid in the upper part and moderate in the lower part. These soils formed in a layer of eolian sand and the underlying loess. Slopes range from 2 to 6 percent.

Libory soils are near Boelus, Elsmere, and Thurman soils on the landscape. Boelus soils do not have mottles above 40 inches, are well drained, and are slightly higher on the landscape. Elsmere soils are somewhat poorly drained, have more sand in the control section, and are lower on the landscape. Thurman soils have more sand in the control section, are somewhat excessively drained, and are slightly higher on the landscape.

Typical pedon of Libory loamy fine sand, 2 to 6 percent slopes, 1,900 feet west and 1,400 feet south of the northeast corner of section 15, T. 23 N., R. 2 W.

A—0 to 14 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; medium acid; clear smooth boundary.

BA—14 to 24 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, friable; medium acid; clear smooth boundary.

2Bw—24 to 36 inches; light brownish gray (10YR 6/2) silty clay loam, grayish brown (10YR 5/2) moist; few fine distinct yellowish brown (10YR 5/6 moist) mottles; weak medium subangular blocky structure; slightly hard, friable; neutral; gradual smooth boundary.

2C1—36 to 50 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct yellowish red (5YR 5/6 moist) mottles; weak coarse prismatic structure; slightly hard, friable; mildly alkaline; gradual smooth boundary.

2C2—50 to 60 inches; light gray (2.5Y 7/2) silty clay loam, light brownish gray (2.5Y 6/2) moist; common fine distinct yellowish red (5YR 5/6 moist) mottles; massive; slightly hard, friable; mildly alkaline.

The depth of the 2B horizon ranges from 20 to 30 inches. The thickness of the solum is 30 to 54 inches. The mollic epipedon is 10 to 20 inches thick. Depth to free carbonates ranges from 40 inches to more than 60 inches.

The A horizon has a value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically loamy fine sand, but the range includes loamy sand and fine sand. Reaction ranges from medium acid through neutral.

The BA horizon has a value of 4 through 6 (2 through 5 moist) and chroma of 2 or 3 (dry or moist). Texture is loamy fine sand or fine sand. Reaction ranges from medium acid through neutral.

The 2B horizon has value of 4 through 6 (3 through 5 moist) and chroma of 2 (dry or moist). Texture is typically silty clay loam, but it ranges to include silt loam. Reaction ranges from slightly acid to mildly alkaline.

The 2C horizon has value of 3 through 7 (2 through 6 moist) and chroma of 2 or 3 (dry or moist). Texture is silty clay loam typically, but in some pedons it is silt loam. Reaction ranges from slightly acid through mildly alkaline.

Loretto Series

The Loretto series consists of deep, well drained, moderately permeable soils on uplands and stream terraces. These soils formed in mixed eolian sand and loess. Slopes range from 0 to 6 percent.

Loretto soils are near Blendon, Boelus, Nora, and Thurman soils on the landscape. Blendon soils have a fine sandy loam B horizon and are slightly lower on the landscape. Boelus soils have more sand in the A horizon and are generally on the same landscape. Nora soils have more clay in the subsoil, less sand in the A horizon, and are on similar landscapes. Thurman soils have more sand in the control section and are slightly higher on the landscape.

Typical pedon of Loretto fine sandy loam, 0 to 2 percent slopes, 250 feet south and 2,400 feet east of the northwest corner of section 7, T. 24 N., R. 3 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; strongly acid; abrupt smooth boundary.

A—7 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable; medium acid; clear wavy boundary.

Bt—16 to 32 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak medium prismatic structure parting to weak fine subangular blocky; hard, friable; slightly acid; gradual wavy boundary.

BC—32 to 52 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic

structure parting to weak medium subangular blocky; hard, friable; slightly acid; gradual wavy boundary.

C—52 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; few coarse faint reddish brown (2.5YR 4/4 moist) mottles; massive; hard, friable; thin strata of sandy loam; neutral.

The thickness of the solum ranges from 36 to 60 inches. The mollic epipedon ranges from 7 to 20 inches in thickness. Depth to carbonates ranges from 40 inches to more than 60 inches.

The A horizon has value of 3 through 5 (2 through 4 moist) and chroma of 1 or 2 (dry or moist). Texture is fine sandy loam or loam. Reaction ranges from strongly acid through slightly acid.

The Bt horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3 (dry or moist). Texture is typically loam or silt loam, but in some pedons it is silty clay loam. Reaction is slightly acid or neutral.

The BC and C horizons have value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4 (dry or moist). These horizons typically have texture of loam or silt loam, but in some pedons it is silty clay loam. In some pedons, the texture is sandy loam below a depth of 40 inches. Reaction is neutral through moderately alkaline.

Loup Series

The Loup series consists of deep, very poorly drained, rapidly permeable soils on bottom lands and stream terraces. These soils formed in sandy alluvium. Slopes range from 0 to 1 percent.

Loup soils are near Elsmere, Inavale, Lawet, and Thurman soils on the landscape. Elsmere soils are somewhat poorly drained and are slightly higher on the landscape. Inavale soils are somewhat excessively drained and are higher on the landscape. Lawet soils have more clay in the control section and are on about the same landscape. Thurman soils are somewhat excessively drained and are higher on the landscape.

Typical pedon of Loup loamy fine sand, wet, 0 to 1 percent slopes, 1,850 feet east and 150 feet south of the northwest corner of section 11, T. 24 N., R. 3 W.

A1—0 to 6 inches; very dark grayish brown (10YR 3/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

A2—6 to 13 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, very friable; neutral; clear smooth boundary.

AC—13 to 19 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; neutral; clear smooth boundary.

C1—19 to 30 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; common medium distinct reddish brown (2.5YR 4/4 moist) mottles; single grain; loose; neutral; gradual wavy boundary.

C2—30 to 60 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; few small faint reddish brown (5YR 5/4 moist) mottles; single grain; loose; mildly alkaline.

Thickness of the solum ranges from 7 to 20 inches. The mollic epipedon is 10 to 20 inches thick. Depth to free carbonates is 0 to 15 inches.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically loamy fine sand, but it ranges to include fine sandy loam and loam. Reaction ranges from neutral through moderately alkaline.

The AC horizon has colors intermediate between those of the A and C horizons. It typically has texture of loamy fine sand, but in some pedons the texture is fine sandy loam. Reaction ranges from neutral to moderately alkaline. Some pedons do not have an AC horizon.

The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 1 or 2 (dry or moist). Reaction is neutral to mildly alkaline.

Marlake Series

The Marlake series consists of deep, very poorly drained, rapidly permeable soils on bottom lands of major streams. These soils formed in sandy alluvium. Slopes range from 0 to 1 percent.

Marlake soils are near Boel, Loup, and Ord soils on the landscape. Boel soils are somewhat poorly drained, have a mollic epipedon, and are higher on the landscape. Loup soils are very poorly drained, have a mollic epipedon, and are slightly higher on the landscape. Ord soils are 20 to 40 inches deep over fine sand, have a mollic epipedon, are somewhat poorly drained, and are higher on the landscape.

Typical pedon of Marlake loam, 0 to 1 percent slopes, 75 feet east and 1,200 feet south of the northwest corner of section 23, T. 24 N., R. 4 W.

Oi—2 inches to 0; partly decayed organic matter.

A—0 to 7 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; massive; hard, very friable; neutral; abrupt wavy boundary.

AC—7 to 17 inches; gray (10YR 5/1) loamy fine sand, dark gray (10YR 4/1) moist; stratified with thin layers of fine sandy loam and fine sand; single grain; soft, very friable; neutral; clear smooth boundary.

C—17 to 60 inches; light gray (10YR 7/1) fine sand, gray (10YR 6/1) moist; few fine distinct light yellowish brown (10YR 6/4 moist) mottles; single grain; loose; mildly alkaline.

Thickness of the solum ranges from 6 to 25 inches. Thickness of the material having mollic color ranges from 6 to 10 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is commonly loam, but it ranges from fine sandy loam to loamy sand. Reaction ranges from neutral through moderately alkaline.

The AC horizon has value of 3 to 7 (2 to 6 moist) and chroma of 1 through 3 (dry or moist). Texture is commonly loamy fine sand, but in places it is loamy sand and fine sand and is stratified with layers that range from sand to silty clay. Reaction ranges from neutral through moderately alkaline.

The C horizon has hue of 10YR through 5Y, value of 5 through 7 (4 through 6 moist), and chroma of 1 through 3 (dry or moist). Texture is typically fine sand, but some pedons are sand and are commonly stratified with finer or coarser material. Mottles range from few to common, faint to prominent, yellowish to reddish. Reaction ranges from neutral through moderately alkaline.

Moody Series

The Moody series consists of deep, well drained soils on uplands and high stream terraces. These soils have moderately slow permeability and formed in loess (fig. 20). Slopes range from 0 to 6 percent.

Moody soils are near Belfore, Fillmore, and Nora soils. Belfore soils have more clay in the control section and are on similar landscapes or higher on the landscape. Fillmore soils are poorly drained, have more clay in the subsoil, and are in depressions lower on the landscape. Nora soils have a thinner B horizon, have free carbonates higher in the profile, and are lower on the landscape.

Typical pedon of Moody silty clay loam, 2 to 6 percent slopes, 625 feet north and 1,575 feet east of the southwest corner of section 19, T. 21 N., R. 3 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and fine subangular blocky structure; hard, friable; slightly acid; abrupt smooth boundary.

BA—7 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse and moderate medium subangular blocky structure; slightly hard, firm; slightly acid; clear wavy boundary.

Bw1—12 to 20 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; neutral; abrupt smooth boundary.

Bw2—20 to 33 inches; yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist;

Figure 20.—Profile of Moody silty clay loam. This deep, well drained soil formed in loess. Depth is marked in feet.

moderate coarse and medium prismatic structure; hard, firm; neutral; clear wavy boundary.

BC—33 to 39 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; few fine faint reddish brown (5YR 4/5 moist) mottles; weak moderate prismatic structure parting to weak moderate subangular blocky; hard, firm; neutral; gradual wavy boundary.

Ck—39 to 48 inches; light yellowish brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) moist; weak coarse prismatic structure; soft, friable; common fine and medium lime concretions; violent effervescence; moderately alkaline; gradual wavy boundary.

C—48 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure; soft, friable; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates range from 30 to 60 inches. The mollic epipedon ranges from 10 to 20 inches in thickness and includes part of the B horizon. Depth to carbonates is typically 39 inches, but ranges from a depth of 30 inches to below 60 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3 (dry or moist). Texture is typically silty clay loam, but in some pedons it is silt loam. Reaction is slightly acid or neutral.

The B horizon has value of 4 through 6 (3 through 5 moist) and chroma of 2 through 4 (dry or moist). Texture is typically silty clay loam, but it includes silt loam. In some pedons the upper part of the B horizon contains more than 35 percent clay, but the control section averages less than 35 percent. Reaction is slightly acid or neutral.

The C horizon has value of 5 through 7 (5 or 6 moist) and chroma of 3 or 4 (dry or moist). Reaction is mildly or moderately alkaline.

Muir Series

The Muir series consists of deep, well drained soils on low stream terraces adjacent to larger streams. These soils are moderately permeable and formed in silty alluvium. Slopes range from 0 to 1 percent.

Muir soils are near Alcester, Gibbon, Hobbs, Nora, and Shell soils on the landscape. Alcester soils are on foot slopes and along intermittent upland drainageways higher on the landscape. Gibbon soils are somewhat poorly drained, do not have a B horizon, and are on bottom lands lower on the landscape. Hobbs soils are stratified above a depth of 10 inches, do not have a B horizon, and are on bottom lands of upland drainageways. Nora soils have a thinner A horizon, have lime higher in the profile, and are on uplands above Muir soils. Shell soils are stratified below a depth of 20 inches, do not have a B horizon, and are lower on the landscape.

Typical pedon of Muir silty clay loam, 0 to 1 percent slopes, 850 feet south and 100 feet west of the northeast corner of section 15, T. 22 N., R. 3 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist: medium fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A—8 to 18 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable; neutral; clear wavy boundary.

BA—18 to 34 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable; neutral; clear wavy boundary.

Bw—34 to 46 inches; grayish brown (10YR 5/2) silty clay loam, dark brown (10YR 3/3) moist; weak fine prismatic structure; slightly hard, friable; neutral; gradual wavy boundary.

C—46 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; massive; soft, friable; neutral.

The thickness of the solum ranges from 24 to 55 inches. The mollic epipedon ranges from 20 inches to more than 40 inches in thickness. Free carbonates are not present above a depth of 50 inches.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically silty clay loam, but it includes silt loam and loam. Reaction ranges from medium acid through neutral.

The B horizon has value of 4 through 6 (2 through 4 moist) and chroma of 2 or 3 (dry or moist). Texture is typically silty clay loam, but it includes silt loam. Reaction ranges from slightly acid through mildly alkaline.

The C horizon has value of 5 through 7 (3 through 5 moist) and chroma of 2 through 4 (dry or moist). Texture is typically silt loam, but it includes loam. Reaction ranges from slightly acid to moderately alkaline. In places, fine sand, loam, or loamy sand is below a depth of 40 inches.

Nora Series

The Nora series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty calcareous loess (fig. 21). Slopes range from 2 to 15 percent.

Nora soils are near Alcester, Crofton, Hobbs, and Moody soils. Alcester soils have a thicker surface layer and are on foot slopes lower on the landscape. Crofton soils do not have a mollic epipedon or a B horizon, have free carbonates at or near the surface, and are on the same landscape as Nora soils. Hobbs soils do not have a B horizon, are stratified, and are in upland

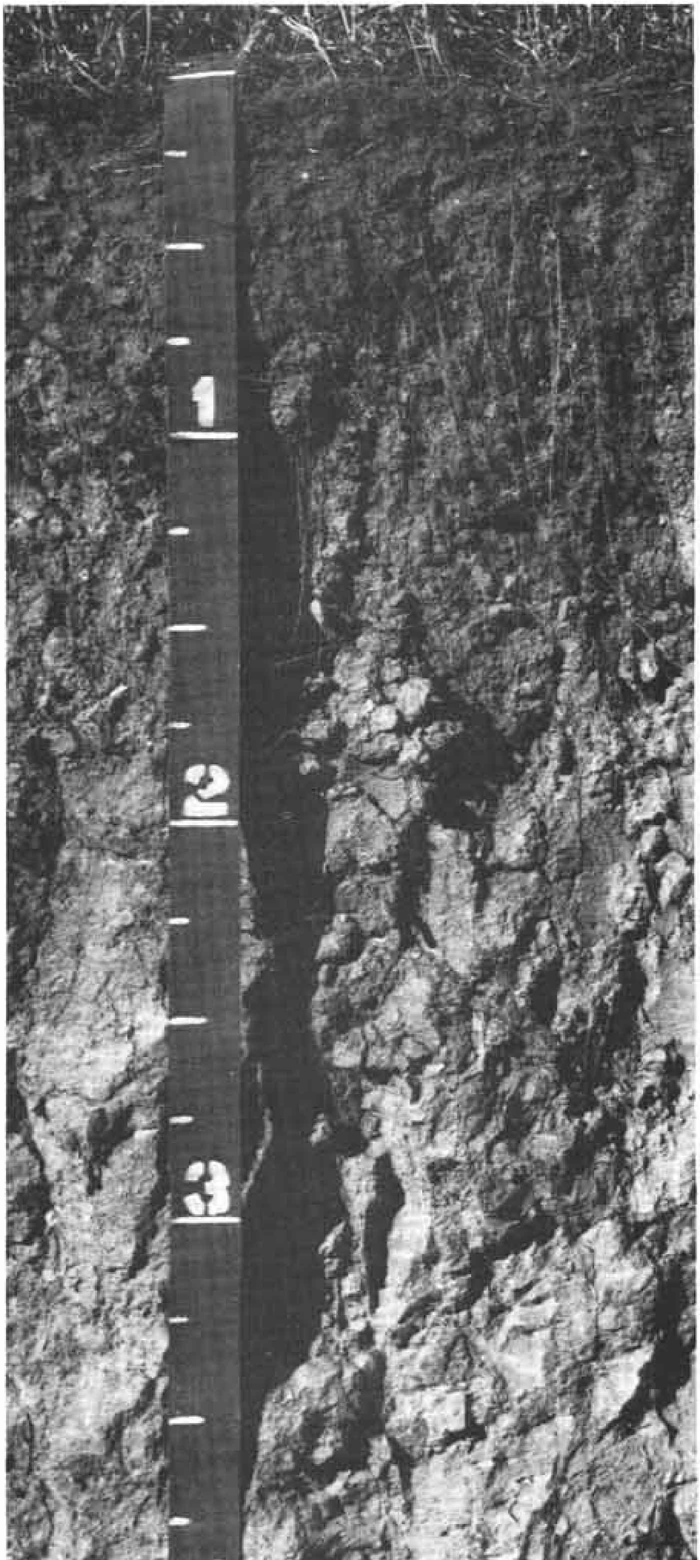

Figure 21.—Profile of Nora silty clay loam. This deep, well drained soil formed in loess. Depth to lime ranges from 13 to 30 inches. Depth is marked in feet.

drainageways lower on the landscape. Moody soils have a thicker B horizon, have free carbonates leached to a greater depth, and are above Nora soils on the landscape.

Typical pedon of Nora silty clay loam, 6 to 11 percent slopes, 200 feet east and 550 feet south of the northwest corner of section 5, T. 21 N., R. 4 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

Bw—7 to 20 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; weak medium prismatic structure; slightly hard, friable; neutral; clear wavy boundary.

BCk—20 to 29 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; weak medium and fine subangular blocky structure; slightly hard, friable; commom medium segregations of lime; violent effervescence; mildly alkaline; clear wavy boundary.

Ck—29 to 42 inches; pale yellow (2.5Y 7/4) silt loam, olive brown (2.5Y 4/4) moist; few fine distinct brownish yellow (10YR 6/6 moist) relict mottles; weak coarse prismatic structure; soft, very friable; common fine and medium segregations of lime; violent effervescence; mildly alkaline; gradual wavy boundary.

C—42 to 60 inches; very pale brown (10YR 7/4) silt loam, yellowish brown (10YR 5/4) moist; weak coarse prismatic structure; soft, very friable; fine disseminated lime; violent effervescence; moderately alkaline.

Thickness of the solum ranges from 20 to 36 inches. Depth to carbonates is typically 18 to 24 inches and ranges from 13 to 30 inches. The mollic epipedon ranges in thickness from 7 to 15 inches and extends into the B horizon.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 2 (dry or moist). Texture is typically silty clay loam, but the range includes silt loam. Reaction is slightly acid or neutral.

The B horizon has value of 5 or 6 (3 or 4 moist) and chroma of 3 or 4 (dry or moist). Texture is silty clay loam or silt loam and averages between 20 and 32 percent clay. Reaction ranges from slightly acid through mildly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4 (dry or moist). Reaction is mildly or moderately alkaline.

Nora soils in map units CuE2, NpC2, and NpD2 of this survey area are taxadjuncts to the Nora series because they have a thinner and lighter colored surface layer

than is defined for the Nora series. This difference does not alter the use or behavior of the soils.

Ord Series

The Ord series consists of deep, somewhat poorly drained soils on bottom lands. Permeability is moderately rapid. These soils formed in stratified alluvium. Slopes range from 0 to 2 percent.

Ord soils are near Boel, Cass, Gibbon, and Inavale soils on the landscape. Boel soils have fine sand above a depth of 20 inches and are slightly lower on the landscape. Cass soils are well drained and slightly higher on the landscape. Gibbon soils have more clay above a depth of 40 inches and are on the same landscape. Inavale soils do not have a mollic epipedon, are somewhat excessively drained, and are slightly higher on the landscape.

Typical pedon of Ord loam, 0 to 1 percent slopes, 100 feet west and 2,560 feet north of the southeast corner of section 28, T. 24 N., R. 3 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—7 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; soft, friable; strong effervescence; mildly alkaline; clear wavy boundary.

AC—16 to 24 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; slight effervescence; mildly alkaline, clear smooth boundary.

C1—24 to 32 inches; light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; few fine faint yellowish brown (10YR 5/4 moist) mottles; massive; soft, very friable; neutral; gradual wavy boundary.

C2—32 to 48 inches; light gray (10YR 7/2) fine sand, light brownish gray (10YR 6/2) moist; few fine distinct olive brown (2.5Y 4/4 moist) mottles; single grain; loose; neutral; gradual wavy boundary.

C3—48 to 60 inches; light brownish gray (2.5Y 6/2) fine sand, grayish brown (10YR 5/2) moist; many fine prominent brown (7.5YR 4/4 moist) mottles; single grain; many very dark brown soft accumulations of iron and manganese; loose; thin strata of loamy fine sand; neutral.

Thickness of the solum ranges from 24 to 35 inches and is commonly the same as the depth to the fine sand. Depth to carbonates ranges from 0 to 20 inches. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is loam or fine sandy loam. Reaction is mildly alkaline or moderately alkaline.

The AC horizon has value of 5 or 6 (4 or 5 moist) and chroma of 1 or 2 (dry or moist). Texture is typically fine sandy loam.

The C horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4 (dry or moist). The upper part is fine sandy loam or sandy loam. The lower part is stratified fine sand and loamy fine sand, and in places includes thin strata of fine sandy loam. Reaction ranges from neutral to moderately alkaline.

Ortello Series

The Ortello series consists of deep, well drained soils on uplands. Permeability is moderately rapid in the upper part of the profile and rapid in the lower part. These soils formed in mixed eolian sands and loess. Slopes range from 2 to 6 percent.

Ortello soils are near Blendon, Boelus, Loretto, and Thurman soils on the landscape. Blendon soils have a pachic horizon and are on stream terraces lower on the landscape. Boelus soils have a coarser texture in the upper part of the control section and are on similar landscapes. Loretto soils have less sand in the B horizon and are on similar landscapes. Thurman soils have a sandy control section, do not have a B horizon, are somewhat excessively drained, and are slightly higher on the landscape.

Typical pedon of Ortello fine sandy loam, 2 to 6 percent slopes, 960 feet south and 690 feet east of center of section 14, T. 24 N., R. 1 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; abrupt smooth boundary.

A—8 to 15 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak medium granular; slightly hard, very friable; slightly acid; clear wavy boundary.

Bw—15 to 30 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

C1—30 to 47 inches; light yellowish brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; single grain; loose; neutral; gradual smooth boundary.

C2—47 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; neutral.

The thickness of the solum ranges from 22 to 36 inches. The mollic epipedon ranges from 8 to 20 inches

in thickness. These soils are generally noncalcareous to below a depth of 60 inches.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 through 3 (dry or moist). Texture is dominantly fine sandy loam, but it also includes loam. Reaction is slightly acid or neutral.

The Bw horizon has value of 4 through 6 (3 or 5 moist) and chroma of 2 through 4 (dry or moist). Texture is dominantly fine sandy loam, but in some pedons it is sandy loam. Reaction is slightly acid or neutral.

The C horizon has value of 6 through 8 (5 or 6 moist) and chroma of 2 through 4 (dry or moist). Reaction is neutral or mildly alkaline. Texture is typically fine sand, but it includes loamy fine sand. In places, it is fine sandy loam in the upper part.

Ovina Series

The Ovina series consists of deep, somewhat poorly drained, moderately permeable soils on low stream terraces and high bottom lands. These soils formed in loamy alluvium. Slopes range from 0 to 2 percent.

Ovina soils are near Boelus, Elsmere, Loretto, Ord, and Thurman soils on the landscape. Boelus and Loretto soils do not have mottles of low chroma above a depth of 40 inches, are well drained, and are slightly higher on the landscape. Elsmere soils have more sand above 40 inches and are slightly higher on the landscape. Ord soils have more sand above 40 inches and are lower on the landscape. Thurman soils are somewhat excessively drained, have a sandy control section, and are higher on the landscape.

Typical pedon of Ovina fine sandy loam, 0 to 2 percent slopes, 2,500 feet south and 1,300 feet east of the northwest corner of section 21, T. 24 N., R. 4 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A—7 to 17 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable; mildly alkaline; abrupt smooth boundary.

C1—17 to 26 inches; light gray (10YR 7/1) loam, grayish brown (2.5Y 5/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable; violent effervescence; moderately alkaline; clear wavy boundary.

C2—26 to 41 inches; light gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; few fine faint yellowish brown (10YR 5/6 moist) mottles; weak medium subangular blocky structure; slightly hard, friable; violent effervescence; few medium lime concretions; moderately alkaline; gradual wavy boundary.

C3—41 to 51 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; a few fine faint yellowish brown (10YR 5/4 moist) mottles; weak medium subangular blocky structure; slightly hard, friable; violent effervescence; few medium lime concretions; moderately alkaline; clear smooth boundary.

C4—51 to 60 inches; light brownish gray (2.5Y 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 20 inches. Depth to free carbonates ranges from 0 to 20 inches. Thickness of the mollic epipedon ranges from 7 to 20 inches.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically fine sandy loam, but the range includes loamy fine sand and, less commonly, loam. Reaction ranges from neutral through moderately alkaline.

The C horizon has hue of 10YR and 2.5Y, value of 5 through 7 (4 through 6 moist), and chroma of 1 or 2 (dry or moist). Texture is typically loam, fine sandy loam, and very fine sandy loam. Some pedons have strata that have textures ranging from loamy fine sand through silty clay loam. Mottles are few or many, faint or distinct. Reaction is mildly alkaline or moderately alkaline.

Shell Series

The Shell series consists of deep, well drained, moderately permeable soils on high bottom lands. These soils formed in silty stratified alluvium. Slopes range from 0 to 1 percent.

Shell soils are near Alcester, Cass, Colo, Hobbs, Muir, and Shell Variant soils on the landscape. Alcester soils show a regular decrease in organic matter with depth, have a B horizon, and are on foot slopes. Cass soils have more sand in the profile and are on similar landscapes. Colo soils are somewhat poorly drained and are slightly lower on the landscape. Hobbs soils are stratified above a depth of 10 inches, do not have a mollic epipedon, and are on bottom lands of narrow upland drainageways. Muir soils are not stratified and are higher on the landscape. Shell Variant soils have more clay in the control section and are on similar landscapes.

Typical pedon of Shell silty clay loam, 0 to 1 percent slopes, 175 feet south and 2,400 feet east of northwest corner of section 29, T. 21 N., R. 4 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; hard, friable; neutral; abrupt smooth boundary.

A—7 to 26 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium to fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

C1—26 to 35 inches; stratified brown (10YR 5/3) and dark grayish brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) and very dark grayish brown (10YR 3/2) moist; weak medium to fine fragments; slightly hard, friable; neutral; clear smooth boundary.
C2—35 to 46 inches; brown (10YR 5/3) silty clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; mildly alkaline; abrupt smooth boundary.
Ab—46 to 60 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; massive; slightly hard, friable; mildly alkaline.

Thickness of the solum and mollic epipedon ranges from 20 to 36 inches.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 2 or 3 (dry or moist). Texture is typically silty clay loam, but ranges to include silt loam and loam. Reaction ranges from slightly acid through neutral.

The C horizon has value of 3 through 6 (2 through 5 moist) and chroma of 2 or 3 (dry or moist). Texture is typically silty clay loam, but it ranges to include silt loam and loam. Reaction ranges from slightly acid through mildly alkaline. In some pedons, free carbonates are below a depth of 48 inches. Some pedons have clay material below a depth of 40 inches. Strata of varying colors are above a depth of 40 inches.

Shell Variant

Shell Variant consists of deep, moderately well drained soils on bottom lands. Permeability is moderate in the upper part of the profile and slow in the lower part. The soils formed in silty and clayey alluvium. Slopes range from 0 to 1 percent.

Shell Variant soils are near Colo, Hobbs, Lamo, and Shell soils on the landscape. Colo and Lamo soils are somewhat poorly drained and are slightly lower on the landscape. Hobbs soils are well drained, are stratified above a depth of 10 inches, and are lower on the landscape. Shell soils are less clayey in the lower horizons and are on the same landscape.

Typical pedon of Shell Variant silty clay loam, 0 to 1 percent slopes, 90 feet south and 2,520 feet east of the northwest corner of section 25, T. 21 N., R. 2 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, friable; medium acid; abrupt smooth boundary.
A—6 to 16 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak medium to fine subangular blocky structure; slightly hard, friable; medium acid; clear smooth boundary.
Bw1—16 to 22 inches; grayish brown (10YR 5/2) silty clay loam, dark brown (10YR 3/3) moist; weak medium to fine subangular blocky structure; slightly hard, friable; slightly acid; clear smooth boundary.
Bw2—22 to 28 inches; brown (10YR 5/3) silty clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; neutral; abrupt smooth boundary.
Ab—28 to 50 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, very firm; mildly alkaline; clear smooth boundary.
C—50 to 60 inches; dark gray (10YR 4/1) silty clay, very dark brown (10YR 2/2) moist; massive; hard, very firm; neutral.

The thickness of the solum is 24 to 36 inches and is the same as the depth of the buried silty clay. The mollic epipedon is 20 inches or more in thickness.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically silty clay loam, but in some pedons it is silt loam. Reaction ranges from medium acid to neutral.

The Bw horizon has value of 4 through 6 (2 through 5 moist) and chroma of 2 or 3 (dry or moist). Texture is typically silty clay loam, but in some pedons it is silt loam. Reaction is slightly acid or neutral.

The Ab and C horizons have value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically silty clay, but it ranges to include clay. Reaction is neutral or mildly alkaline.

Thurman Series

The Thurman series consists of deep, somewhat excessively drained, rapidly permeable soils on uplands and stream terraces. These soils formed in eolian sand. Slopes range from 0 to 11 percent.

Thurman soils are near Boelus, Elsmere, Hadar, Loretto, and Valentine soils on the landscape. Boelus and Loretto soils have a loamy B horizon and are lower on the landscape. Elsmere soils are somewhat poorly drained and are lower on the landscape. Hadar soils are well drained, have more clay and less sand in the control section, and are lower on the landscape. Valentine soils have a thinner surface layer and are on ridgetops above Thurman soils.

Typical pedon of Thurman loamy fine sand, 3 to 6 percent slopes, 75 feet south and 1,850 feet east of northwest corner, section 16, T. 24 N., R. 3 W.

A—0 to 12 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable; medium acid; abrupt smooth boundary.
AC—12 to 17 inches; grayish brown (10YR 5/2) loamy fine sand, dark brown (10YR 3/3) moist; weak medium granular structure; soft, very friable; medium acid; clear wavy boundary.

C1—17 to 29 inches; light yellowish brown (10YR 6/4) fine sand, dark yellowish brown (10YR 4/4) moist; single grain; loose; slightly acid; gradual smooth boundary.
C2—29 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grain; loose; slightly acid.

The thickness of the solum ranges from 14 to 28 inches. Free carbonates are not present to a depth of 60 inches. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2 (dry or moist). Texture is typically loamy fine sand, but it includes fine sand. Reaction is medium acid or slightly acid. The AC horizon has value of 4 or 5 (3 or 4 moist) and chroma of 1 through 3 (dry or moist.) Texture is typically loamy fine sand, but it includes fine sand. Reaction is slightly acid or neutral.

The C horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 through 4 (dry or moist). Texture is typically fine sand, but includes loamy fine sand. Reaction is neutral or mildly alkaline.

Valentine Series

The Valentine series consists of deep, excessively drained, rapidly permeable soils. These soils formed in eolian sand on uplands. Slopes range from 3 to 20 percent.

Valentine soils are near Boelus, Elsmere, and Thurman soils on the landscape. Boelus soils have a thicker A horizon, are well drained, and are lower on the landscape. Elsmere soils have a thicker A horizon, are somewhat poorly drained, and are in sandhill valleys and on low stream terraces. Thurman soils have a thicker A horizon, are somewhat excessively drained, and are lower on the landscape.

Typical pedon of Valentine fine sand, 3 to 9 percent slopes, 250 feet south and 530 feet east of the northwest corner of section 12, T. 24 N., R. 3 W.

A—0 to 6 inches; dark grayish brown (10YR 4/2) fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; loose; medium acid; abrupt smooth boundary.
AC—6 to 10 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; single grain; loose; slightly acid; clear wavy boundary.
C1—10 to 16 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose; slightly acid; gradual wavy boundary.
C2—16 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grain; loose; neutral.

The thickness of the solum ranges from 5 to 17 inches. Reaction ranges from medium acid through neutral throughout the profile.

The A horizon has value of 4 through 6 (3 through 5 moist) and chroma of 2 (dry or moist). Texture is typically fine sand, but the range includes loamy fine sand.

The AC horizon has value of 5 through 7 (4 through 6 moist) and chroma of 2 or 3 (dry or moist). Texture is typically fine sand, but the range includes loamy fine sand.

The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 through 4 (dry or moist).

Zook Series

The Zook series consists of deep, poorly drained soils on bottom lands. These soils formed in clayey and silty alluvium. Permeability is slow. Slopes range from 0 to 1 percent.

Zook soils are near Cass, Gibbon, Muir, and Shell soils. Cass soils are well drained, have more sand and less clay in the control section, and are slightly higher on the landscape. Gibbon soils have less clay in the control section and are on about the same landscape positions. Muir soils are well drained, have less clay in the control section, and are higher on the landscape. Shell soils are well drained, have less clay in the control section, and are higher on the landscape.

Typical pedon of Zook silty clay loam, 0 to 1 percent slopes, 500 feet south and 50 feet east of the northwest corner of section 10, T. 24 N., R. 1 W.

Ap—0 to 7 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; moderate fine subangular blocky structure; slightly hard, friable; neutral; abrupt smooth boundary.
A1—7 to 13 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; moderate fine subangular blocky structure; slightly hard, friable; neutral; clear wavy boundary.
A2—13 to 21 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; moderate medium subangular blocky structure; hard, firm; neutral; gradual smooth boundary.
AB—21 to 34 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium blocky structure; hard, firm; neutral; gradual smooth boundary.
Bg—34 to 47 inches; gray (10YR 5/1) silty clay, very dark grayish brown (10YR 3/2) moist; weak medium blocky structure; hard, firm; slight effervescence; moderately alkaline; gradual wavy boundary.
Cg—47 to 60 inches; gray (5Y 5/1) silty clay, dark gray (5Y 4/1) moist; few fine distinct yellowish brown (10YR 5/4 moist) mottles; massive; hard, firm; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 36 inches to more than 60 inches. The mollic epipedon ranges from 36 to 50 inches in thickness.

The A horizon has value of 3 or 4 (2 or 3 moist). It is typically silty clay loam in the upper part and silty clay below a depth of 13 inches.

The Bg and Cg horizons have hue of 10YR or 5Y and value of 4 through 6 (3 through 5 moist). The solum below a depth of about 13 inches contains between 36 and 45 percent clay, and the amount of clay commonly remains constant to a depth of about 4 feet or more.

Factors of Soil Formation

Soil is produced by soil forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent Material

Parent material is the unconsolidated material from which a soil has formed. It influences the chemical and mineralogical composition of the soil.

In Madison County the soils formed in glacial till, loess, colluvium, alluvium, and eolian sand.

Glacial till is the oldest material in which soils in Madison County were formed. Glacial till is at the surface in a small area in the northeast part of Madison County. It is mainly light gray clay loam and sandy clay containing much segregated lime and many yellowish brown and dark brown mottles. Clarno soils formed in glacial till, as did the middle and lower horizons of the Hadar soils.

Peoria loess is the most extensive parent material in the county. It consists of a pale brown or light grayish brown, calcareous, silty, wind-deposited material. This material covers most of the uplands in Madison County. The loess is mainly of Peorian age and ranges from 30 to 70 feet thick. Belfore, Crofton, Moody, and Nora soils formed in loess.

Colluvium is material that accumulates on foot slopes as a result of the combined forces of gravity and water. This parent material is on foot slopes in the loess uplands. The gently sloping Alcester soils formed in this material.

Alluvium is the parent material of the soils on bottom lands and stream terraces. It is a mixture of sand, silt, and clay that has been deposited by overflowing streams. The flood plains continue to receive sediments from floodwaters, and soil development is slight. Sedimentation is responsible for textural differences in the horizons of the soils. Boel, Cass, Colo, Gibbon, Gayville, Hobbs, Inavale, Lamo, Loup, Marlake, Ord, Ovina, and Shell soils formed in alluvium on bottom lands. The oldest alluvium is on the stream terraces that are above the present flood plain. Muir soils formed in alluvium on low stream terraces that are seldom flooded.

Eolian, or wind-deposited, sandy parent materials are found mainly north and south of the Elkhorn River. In some places sand is the sole parent material, but in other places it is mixed with loess. The local source of the eolian sands was alluvium on the Elkhorn River flood plain. It was picked up by the wind and deposited on the uplands.

Eolian sand parent material consists of loose, single grained pale brown or very pale brown fine sand and loamy fine sand. Thurman and Valentine soils formed in deep deposits of this material. The upper part of the Boelus and Hadar soils also formed in eolian sand.

Climate

Madison County has a subhumid temperate climate. It is characterized by a moderate amount of moisture for soil development processes, a temperature range that nearly stops soil development for about 3 months during the winter season, intense rain storms that result in runoff on slopes and flooding of the valleys, and winds that shift the materials of the sandy soils.

The average annual precipitation is about 25 inches. This is sufficient moisture to allow development of soils that have a dark surface layer and contain a moderate amount of organic matter. In most silty soils lime has been leached from the surface layer and the upper part

of the subsoil and has accumulated in the lower part of the subsoil or in the substratum. Sandy soils on uplands have been leached of lime throughout the profile. In a few soils, such as Belfore, soil development processes have resulted in the movement of some clay from the surface layer into the subsoil. Excessive rain or rapid snowmelt results in flooding and the consequent deposition of sediment on bottom lands.

The native grass vegetation and the warm summers and cold winters in Madison County have favored the development of soils that have a dark surface layer. The average depth of frost penetration is about 24 inches, and summer temperatures reach or exceed 100° F a few days each year. Alternate freezing and thawing and wetting and drying aid in the formation of a granular surface layer and a prismatic or blocky structure in the subsoil. Summer heat and moisture speed chemical weathering.

Prevailing northwesterly winds in winter months help determine the distribution of the eolian sands and loessial parent materials.

In many places in cultivated fields, runoff from hard rains has eroded the dark surface layer and reduced the fertility of the soils. Wind has eroded many areas of the coarse and moderately coarse soils, and in some areas all of the original dark surface layer has been removed. The materials removed by erosion have for the most part been redeposited not far from their original site. The materials eroded by water are moved down gradient to the lower slopes, foot slopes, and bottom lands. Those eroded by wind are moved about the field or into adjacent fields.

The availability of plant nutrients is dependent upon the decomposition of the organic matter by micro-organisms and chemical weathering of the mineral soil material. Micro-organisms in the soil are most active in a moderate temperature and moisture range. Chemical reactions are slowed by low temperatures and speeded by high temperatures. The temperature and moisture in the soil control the weathering of parent material and the decomposition of the organic matter.

The humidity in Madison County generally is low, and a fairly high degree of water loss takes place through evaporation and transpiration. These processes reduce the amount of water for vegetative growth, decomposition of organic matter, chemical weathering, and leaching of soluble material from the soil.

Plants and Animals

Prior to settlement, vegetation in Madison County was mainly mid and tall prairie grasses. These grasses have a fibrous root system that fills the surface layer with minute rootlets. The decay of these rootlets produces organic matter and helps to promote the development of a granular structure in the soil. Deeper roots improve the permeability of the subsoil and add a small amount of organic matter. Most soils in Madison County have a friable or very friable, dark surface layer, which is a result, in large measure, of the organic matter that is present.

Micro-organisms, worms, insects, gophers, and other small animals have an important influence on the development of the soils in Madison County. Micro-organisms decompose organic matter, changing it into humus from which growing plants can obtain nutrients and through which minerals are returned to the soil. Earthworms and small burrowing animals help mix this humus with the soil. When animals die, their bodies are returned to the soil, adding organic matter. Such material gives the upper part of the soil its dark color and influences its physical and chemical composition. Soils in Madison County that have the highest amounts of organic matter are Gibbon, Lamo, and Muir. Such soils as Crofton, Inavale, and Valentine have the least amount.

Plants bring nutrients to the surface and return nutrients as they decay. The decaying grass roots and tops are rich in calcium, which helps to keep the soil porous. The decomposition of organic matter forms organic acids that, when dissolved in water, hasten the leaching process.

Human activities also affect soil formation. Cultivation accelerates soil loss; conservation tillage practices and terraces help prevent excessive soil loss. Fertilizer and the use of irrigation water alter the soil. The activities of man have an immediate effect on the soil characteristics but a relatively minor effect on soil development.

Relief

Relief affects soil formation mainly through its influence on runoff, erosion, temperature, aeration, and drainage. Runoff is more rapid on steep and very steep slopes than on milder slopes. Consequently, on steeper slopes plant growth generally is less vigorous, less water penetrates the soil, soil horizons are thinner and less distinct, and lime is not so deeply leached. Erosion is more severe on the steeper slopes if all other factors are equal.

Even in soils that have the same parent material, the influence of relief is evident in the color, thickness, and horizonation of the soils. The gradient, shape, length, and direction of slope influence the amount of moisture in the soil. Steep and very steep soils, such as Crofton soils, are weakly developed, have a thin surface layer, and have lime at or near the surface. In Moody soils, which are not quite so steep, the surface layer is thicker, lime is leached to a greater depth, and a subsoil has formed. In the nearly level Belfore soils, the surface layer is dark and thick, the subsoil is well developed, and lime is leached to a greater depth. Crofton, Moody, Belfore, and Nora soils all formed in Peoria loess under grass

vegetation, and consequently their differences can largely be attributed to differences in relief.

Such soils as Boel, Cass, Colo, Gibbon, Hobbs, Inavale, Lamo, Lawet, Loup, Marlake, Ord, Ovina, Shell, and Zook soils are on bottom lands and have low relief. Soil formation is slight on bottom lands because the soils commonly receive new sediment from flooding. Each period of flooding provides new parent material and starts a new cycle of soil formation. An example of a soil that formed on bottom lands and is frequently flooded is Hobbs silt loam, channeled.

Time

Time is required to change soil parent material into a soil. Organic matter accumulates and darkens the surface in a short time. Commonly, within a few decades the darkened horizon becomes several inches thick. Leaching of carbonates starts almost immediately but progresses slowly. Horizons in the subsoil are slow to develop, and most do not form until the carbonates have been leached and clay formation begins.

Slopes are constantly being changed by the geomorphic processes that alter the landscape. Vegetation may be wiped out or affected by natural hazards, fire, wind, erosion, or climatic change. Climate and organisms seem to be less subject to change than the other factors. However, ice ages and extreme drought are a matter of record, and both have a strong influence on the number and kind of organisms and their rate of activity. Warmth and moisture speed soil formation; cold and dry climates slow formation.

The concept of soil maturity relates time to the other four soil-forming factors. The maturity of a soil depends on the interaction of all five factors. A mature soil is in equilibrium with its environment—it has progressed to the limit of development in its position and climate. The degree of development can be rated in terms of horizon development, depth of leaching, clay movement, and other characteristics. Soils that do not have well developed and distinct horizons are commonly considered to be immature, and it is assumed that with time they will continue to undergo change and development. Soils that have well developed horizons are considered to be more mature and stable.

Belfore and Moody soils represent soil development that has been progressing toward maturity over a long period of time. The dark surface indicates that organic matter has accumulated, the carbonates have been leached, and fairly distinct subsoil horizons have formed. The steep Crofton soil is an example of a soil that has undergone only slight soil development. Although organic matter has darkened the surface, leaching has scarcely removed the carbonates from the dark colored surface layer, subsoil horizons are faint or nonexistent, and clay formation and clay movement have not started.

Radiocarbon dating has been used to pinpoint the age of the carbonates in some soils and to date some of the soil parent materials. The dates establish a maximum age limit for soils developed on a dated parent material, but this does not assure that a soil has the oldest possible age. Radiocarbon dates indicate that the age of Peoria loess ranges between 15,000 and 30,000 years old. The reddish brown Loveland Formation that occasionally crops out on hillsides in Madison County is much older. Upland sands are less than 10,000 years old, and the alluvium in the valleys varies from a few years to a few hundred years in age.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the

surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves all or part of the crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazingland for a prescribed period.

Depth, classes. The total thickness of soil material over coarse sand or mixed sand and gravel is given the following classes: *very shallow,* 0 to 10 inches; *shallow,* 10 to 20 inches; *moderately deep,* 20 to 40 inches; and *deep,* more than 40 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly

continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, not to the range or geographical distribution of the species.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-

forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent drainageway. A stream or portion of a stream that flows mostly in direct response to precipitation. It receives little or no water from springs and no long-continued supply from melting snow or other sources. It is dry for a large part of the year, ordinarily more than 3 months.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor

aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter content. The classes used in this survey are *very low,* less than 0.5 percent organic matter present; *low,* 0.5 to 1.0 percent; *moderately low,* 1.0 to 2.0 percent; *moderate,* 2.0 to 4.0 percent; and *high,* 4.0 to 8.0 percent.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction

because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Scalp planting (till planting). Seedbed preparation in which sod or other vegetation is removed in spots or strips and pushed aside, leaving a protective cover between rows.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the classes of slope are:

Nearly level	0 to 2 percent
Very gently sloping	1 to 3 percent
Gently sloping	2 to 6 percent
Strongly sloping	6 to 11 percent
Moderately steep	11 to 15 percent
Steep	15 to 30 percent
Very steep	more than 30 percent

Slow intake (in tables). The slow movement of water into the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive*

(the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subbase. A layer of granular material between the base and the subgrade (foundation layer) of a pavement. It is principally used in areas of very weak soil or deep frost penetration.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. Includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Till planting. Seedbed preparation for row crops by scalping the area of the old crop row and pushing soil and residue aside, leaving a protective cover of crop residue on and mixed in the surface layer between the crop rows. Seedbed preparation and planting are completed in the same operation.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-78 at Madison, Nebraska]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	31.1	7.5	19.4	58	-25	0	0.48	0.13	0.75	2	4.9
February---	38.1	14.3	26.2	67	-17	7	.85	.21	1.35	3	5.9
March------	47.3	23.5	35.5	81	-5	39	1.47	.51	2.28	4	6.6
April------	64.1	36.9	50.5	89	15	113	2.39	1.20	3.41	6	1.0
May--------	74.8	48.3	61.6	94	26	366	4.16	2.22	5.85	8	.0
June-------	84.5	58.3	71.4	101	40	642	4.59	2.48	6.44	7	.0
July-------	89.3	63.1	76.2	103	46	812	3.33	1.74	4.71	6	.0
August-----	86.9	60.7	73.8	99	44	738	3.01	1.16	4.54	6	.0
September--	77.9	50.3	64.1	97	28	423	2.23	.86	3.37	5	.0
October----	67.6	38.3	52.9	90	17	162	1.41	.34	2.27	3	.3
November---	49.4	24.7	37.0	75	0	0	.74	.10	1.22	2	2.5
December---	36.7	13.9	25.3	65	-17	0	.63	.23	.97	2	6.6
Yearly:											
Average--	62.3	36.7	49.5	---	---	---	---	---	---	---	---
Extreme--	---	---	---	103	-26	---	---	---	---	---	---
Total----	---	---	---	---	---	3,302	25.29	20.16	30.31	54	27.8

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-78 at Madison, Nebraska]

Probability	Temperature: 24° F or lower	Temperature: 28° F or lower	Temperature: 32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 27	May 15	May 23
2 years in 10 later than--	April 22	May 9	May 18
5 years in 10 later than--	April 13	April 28	May 8
First freezing temperature in fall:			
1 year in 10 earlier than--	October 6	September 23	September 15
2 years in 10 earlier than--	October 11	September 28	September 20
5 years in 10 earlier than--	October 21	October 7	September 30

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-78 at Madison, Nebraska]

Probability	Length of growing season if daily minimum temperature is--: Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	168	142	126
8 years in 10	176	149	132
5 years in 10	190	161	144
2 years in 10	205	173	156
1 year in 10	212	179	162

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
AcC	Alcester silty clay loam, 2 to 6 percent slopes	22,100	6.0
BdC	Bazile loam, 2 to 6 percent slopes	430	0.1
Be	Belfore silty clay loam, 0 to 2 percent slopes	14,900	4.1
Bn	Blendon fine sandy loam, 0 to 2 percent slopes	3,380	0.9
Bp	Boel fine sandy loam, 0 to 2 percent slopes	1,600	0.4
Br	Boel loamy fine sand, channeled	370	0.1
BsC	Boelus loamy fine sand, 2 to 6 percent slopes	8,760	2.4
Cf	Cass fine sandy loam, 0 to 2 percent slopes	1,320	0.4
Cg	Cass loam, 0 to 1 percent slopes	910	0.2
CnC	Clarno loam, 2 to 6 percent slopes	360	0.1
Co	Colo silty clay loam, 0 to 1 percent slopes	900	0.2
CrC2	Crofton silt loam, 2 to 6 percent slopes, eroded	390	0.1
CrD2	Crofton silt loam, 6 to 11 percent slopes, eroded	780	0.2
CrF	Crofton silt loam, 15 to 30 percent slopes	2,360	0.6
CrG	Crofton silt loam, 30 to 60 percent slopes	260	0.1
CuE2	Crofton-Nora complex, 11 to 15 percent slopes, eroded	11,840	3.2
Eh	Elsmere loamy fine sand, 0 to 2 percent slopes	11,480	3.1
Ek	Elsmere fine sandy loam, 0 to 1 percent slopes	1,070	0.3
Fm	Fillmore silt loam, 0 to 1 percent slopes	680	0.2
Gk	Gibbon silty clay loam, 0 to 1 percent slopes	8,690	2.4
Gs	Gibbon-Gayville silty clay loams, 0 to 1 percent slopes	2,020	0.6
HaC	Hadar loamy fine sand, 2 to 6 percent slopes	900	0.2
Hd	Hobbs silt loam, 0 to 2 percent slopes	15,850	4.3
He	Hobbs silt loam, channeled	4,670	1.3
InB	Inavale loamy fine sand, 0 to 3 percent slopes	1,430	0.4
Ip	Inavale-Boel complex, 0 to 6 percent slopes	3,090	0.8
La	Lamo silty clay loam, 0 to 1 percent slopes	3,350	0.9
Lc	Lamo silty clay loam, wet, 0 to 1 percent slopes	1,910	0.5
Le	Lamo silt loam, 0 to 1 percent slopes	390	0.1
Lf	Lawet loam, 0 to 1 percent slopes	940	0.3
LgC	Libory loamy fine sand, 2 to 6 percent slopes	1,270	0.3
Lo	Loretto fine sandy loam, 0 to 2 percent slopes	1,500	0.4
LoC	Loretto fine sandy loam, 2 to 6 percent slopes	3,220	0.9
Lp	Loretto loam, 0 to 2 percent slopes	1,260	0.3
LpC	Loretto loam, 2 to 6 percent slopes	5,500	1.5
Lt	Loup loamy fine sand, wet, 0 to 1 percent slopes	1,400	0.4
Ma	Marlake loam, 0 to 1 percent slopes	350	0.1
Mo	Moody silty clay loam, 0 to 2 percent slopes	720	0.2
MoC	Moody silty clay loam, 2 to 6 percent slopes	37,830	10.3
Mp	Moody silty clay loam, terrace, 0 to 1 percent slopes	3,190	0.9
Mu	Muir silty clay loam, 0 to 1 percent slopes	10,620	2.9
NoC	Nora silty clay loam, 2 to 6 percent	4,360	1.2
NoD	Nora silty clay loam, 6 to 11 percent slopes	18,770	5.1
NoE	Nora silty clay loam, 11 to 15 percent slopes	1,620	0.4
NpC2	Nora-Crofton complex, 2 to 6 percent slopes, eroded	7,970	2.2
NpD2	Nora-Crofton complex, 6 to 11 percent slopes, eroded	77,534	21.0
Og	Ord fine sandy loam, 0 to 2 percent slopes	3,130	0.9
Oh	Ord loam, 0 to 1 percent slopes	3,950	1.1
OtC	Ortello fine sandy loam, 2 to 6 percent slopes	820	0.2
Ov	Ovina fine sandy loam, 0 to 2 percent slopes	1,520	0.4
Pb	Pits and Dumps	470	0.1
Sm	Shell silt loam, 0 to 1 percent slopes	4,940	1.3
Sn	Shell silty clay loam, 0 to 1 percent slopes	3,420	0.9
Sv	Shell Variant silty clay loam, 0 to 1 percent slopes	1,830	0.5
ThB	Thurman loamy fine sand, 1 to 3 percent slopes	12,180	3.3
ThC	Thurman loamy fine sand, 3 to 6 percent slopes	15,800	4.3
ThD	Thurman loamy fine sand, 6 to 11 percent slopes	1,670	0.5
Tm	Thurman loamy fine sand, thick, 0 to 2 percent slopes	8,640	2.4
VaD	Valentine fine sand, 3 to 9 percent slopes	3,160	0.9
VaF	Valentine fine sand, 9 to 20 percent slopes	520	0.1
Zo	Zook silty clay loam, 0 to 1 percent slopes	730	0.2
	Water areas less than 40 acres in size	1,200	0.3
	Water area over 40 acres in size	102	*
	Total	368,326	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
AcC	Alcester silty clay loam, 2 to 6 percent slopes
BdC	Bazile loam, 2 to 6 percent slopes
Be	Belfore silty clay loam, 0 to 2 percent slopes
Bn	Blendon fine sandy loam, 0 to 2 percent slopes
Cf	Cass fine sandy loam, 0 to 2 percent slopes
Cg	Cass loam, 0 to 1 percent slopes
CnC	Clarno loam, 2 to 6 percent slopes
Co	Colo silty clay loam, 0 to 1 percent slopes (where drained)
CrC2	Crofton silt loam, 2 to 6 percent slopes, eroded
Gk	Gibbon silty clay loam, 0 to 1 percent slopes (where drained)
Hd	Hobbs silt loam, 0 to 2 percent slopes
La	Lamo silty clay loam, 0 to 1 percent slopes (where drained)
Lo	Loretto fine sandy loam, 0 to 2 percent slopes
LoC	Loretto fine sandy loam, 2 to 6 percent slopes
Lp	Loretto loam, 0 to 2 percent slopes
LpC	Loretto loam, 2 to 6 percent slopes
Mo	Moody silty clay loam, 0 to 2 percent slopes
MoC	Moody silty clay loam, 2 to 6 percent slopes
Mp	Moody silty clay loam, terrace, 0 to 1 percent slopes
Mu	Muir silty clay loam, 0 to 1 percent slopes
NoC	Nora silty clay loam, 2 to 6 percent slopes
NpC2	Nora silty clay loam, 2 to 6 percent slopes, eroded
Og	Ord fine sandy loam, 0 to 2 percent slopes
Oh	Ord loam, 0 to 1 percent slopes
OtC	Ortello fine sandy loam, 2 to 6 percent slopes
Ov	Ovina fine sandy loam, 0 to 2 percent slopes
Sm	Shell silt loam, 0 to 1 percent slopes
Sn	Shell silty clay loam, 0 to 1 percent slopes
Sv	Shell Variant silty clay loam, 0 to 1 percent slopes
Zo	Zook silty clay loam, 0 to 1 percent slopes (where drained)

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn		Grain sorghum		Soybeans		Oats		Alfalfa hay		Pasture	
	N	I	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	AUM*	AUM*
AcC----------------------- Alcester	85	135	90	125	33	42	75	---	4.5	6.5	5.0	12.0
BdC----------------------- Bazile	55	120	60	115	30	37	45	---	3.1	5.4	3.7	9.0
Be------------------------ Belfore	83	140	83	120	35	45	70	---	3.8	6.0	4.4	10.0
Bn------------------------ Blendon	62	135	63	115	25	40	60	---	2.6	5.5	2.9	11.0
Bp------------------------ Boel	50	110	60	100	25	35	40	---	3.0	4.8	3.5	9.0
Br------------------------ Boel	---	---	---	---	---	---	---	---	---	---	---	---
BsC----------------------- Boelus	58	130	73	115	24	40	43	---	3.3	5.2	2.4	9.0
Cf------------------------ Cass	65	135	70	120	25	40	40	---	3.5	5.5	3.6	11.0
Cg------------------------ Cass	68	135	75	120	30	42	45	---	3.8	5.5	3.8	11.0
CnC----------------------- Clarno	70	125	70	95	27	32	65	---	3.5	5.2	3.5	11.0
Co------------------------ Colo	90	135	85	125	35	40	70	---	4.0	6.0	5.0	12.0
CrC2---------------------- Crofton	63	95	58	78	24	30	38	---	2.7	4.0	2.5	9.0
CrD2---------------------- Crofton	58	85	53	73	---	---	35	---	2.6	4.0	2.1	9.0
CrF----------------------- Crofton	---	---	---	---	---	---	---	---	---	---	---	---
CrG----------------------- Crofton	---	---	---	---	---	---	---	---	---	---	---	---
CuE2---------------------- Crofton-Nora	56	---	53	---	---	---	34	---	2.4	---	2.1	---
Eh------------------------ Elsmere	55	105	50	105	20	---	30	---	2.5	4.5	3.5	10.0
Ek------------------------ Elsmere	60	110	54	108	25	---	35	---	2.8	4.8	3.8	10.2
Fm------------------------ Fillmore	45	110	55	105	20	---	35	---	2.0	3.5	4.0	---
Gk------------------------ Gibbon	85	130	87	120	34	39	---	---	4.0	6.0	5.0	12.0
Gs------------------------ Gibbon-Gayville	65	90	68	95	25	34	---	---	3.0	4.8	3.0	8.0

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Grain sorghum		Soybeans		Oats		Alfalfa hay		Pasture	
	N	I	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	AUM*	AUM*
HaC----------------------- Hadar	57	120	70	115	25	38	50	---	3.5	---	---	---
Hd------------------------ Hobbs	80	135	83	115	33	40	70	---	4.0	6.0	5.0	12.0
He------------------------ Hobbs	---	---	---	---	---	---	---	---	---	---	---	---
InB----------------------- Inavale	33	90	38	80	20	---	30	---	2.0	4.0	2.0	7.0
Ip------------------------ Inavale-Boel	---	---	---	---	---	---	---	---	---	---	---	---
La------------------------ Lamo	80	125	85	120	32	40	---	---	4.2	6.2	5.0	12.0
Lc------------------------ Lamo	---	---	---	---	---	---	---	---	---	---	---	---
Le------------------------ Lamo	70	---	75	---	35	---	---	---	4.5	---	---	---
Lf------------------------ Lawet	60	---	52	---	---	---	---	---	3.0	4.6	5.0	---
LgC----------------------- Libory	58	115	60	110	---	---	---	---	3.0	5.0	2.5	9.0
Lo------------------------ Loretto	79	138	88	122	28	38	68	---	4.4	6.5	3.9	11.0
LoC----------------------- Loretto	70	130	78	118	28	35	63	---	3.9	6.0	3.2	10.0
Lp------------------------ Loretto	80	140	92	125	30	42	73	---	4.4	6.5	4.3	11.5
LpC----------------------- Loretto	74	132	83	120	28	40	68	---	4.2	6.3	4.0	11.0
Lt------------------------ Loup	---	---	---	---	---	---	---	---	---	---	---	---
Ma------------------------ Marlake	---	---	---	---	---	---	---	---	---	---	---	---
Mo------------------------ Moody	85	140	88	125	31	42	73	---	4.2	6.2	4.4	12.0
MoC----------------------- Moody	79	130	81	120	29	40	73	---	3.8	6.0	3.9	11.0
Mp------------------------ Moody	87	140	90	125	32	42	80	---	4.5	6.4	4.5	13.0
Mu------------------------ Muir	90	150	92	130	35	45	80	---	4.5	6.5	4.5	13.0
NoC----------------------- Nora	76	130	79	120	29	38	69	---	3.7	5.8	4.2	10.5
NoD----------------------- Nora	68	115	70	110	24	32	60	---	3.0	5.2	3.5	10.0
NoE----------------------- Nora	59	---	69	---	19	---	53	---	2.9	---	2.9	---

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn		Grain sorghum		Soybeans		Oats		Alfalfa hay		Pasture	
	N	I	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Ton	Ton	AUM*	AUM*
NpC2------------------------ Nora-Crofton	70	120	68	115	25	35	52	---	3.4	5.0	3.9	10.0
NpD2------------------------ Nora-Crofton	66	100	63	95	---	---	41	---	2.9	4.5	2.9	9.0
Og-------------------------- Ord	55	115	65	105	26	36	40	---	3.0	5.5	3.7	9.0
Oh-------------------------- Ord	60	120	70	110	30	38	45	---	3.5	5.7	3.9	9.5
OtC------------------------- Ortello	58	120	68	110	27	34	---	---	3.0	5.5	3.0	9.5
Ov-------------------------- Ovina	60	115	60	110	25	36	45	---	3.5	5.0	---	---
Pb-------------------------- Pits and Dumps	---	---	---	---	---	---	---	---	---	---	---	---
Sm-------------------------- Shell	88	145	85	130	36	44	72	---	4.2	6.2	4.9	13.0
Sn-------------------------- Shell	85	145	85	130	35	42	72	---	4.2	6.2	5.0	13.0
Sv-------------------------- Shell Variant	82	140	80	125	35	42	70	---	4.0	6.0	5.0	12.5
ThB------------------------- Thurman	58	115	61	110	---	---	31	---	2.4	4.5	1.9	9.5
ThC------------------------- Thurman	54	100	58	95	---	---	28	---	1.9	4.0	1.7	6.5
ThD------------------------- Thurman	---	95	---	90	---	---	25	---	---	3.9	---	---
Tm-------------------------- Thurman	61	120	64	115	---	---	31	---	2.6	4.9	2.5	10.0
VaD------------------------- Valentine	---	87	---	---	---	---	---	---	---	3.5	---	8.0
VaF------------------------- Valentine	---	---	---	---	---	---	---	---	---	---	---	---
Zo-------------------------- Zook	80	120	82	115	32	40	68	---	4.2	5.5	4.5	10.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I (N)	30,690	---	---	---	---
(I)	30,690	---	---	---	---
II (N)	124,050	71,650	47,700	4,700	---
(I)	53,900	4,880	47,700	1,320	---
III (N)	157,624	140,884	16,740	---	---
(I)	134,920	116,160	16,740	2,020	---
IV (N)	39,780	36,820	940	---	---
(I)	115,570	115,570	940	---	---
V (N)	3,680	---	3,680	---	---
VI (N)	10,120	2,360	7,760	---	---
VII (N)	260	260	---	---	---
VIII(N)	820	---	350	470	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
AcC: Alcester	---	Tatarian honeysuckle, Siberian peashrub, American plum, lilac.	Bur oak, blue spruce, hackberry, Russian-olive, eastern redcedar.	Honeylocust, ponderosa pine, green ash.	---
BdC: Bazile	---	Tatarian honeysuckle, American plum, lilac, Siberian peashrub.	Hackberry, Russian-olive, bur oak, eastern redcedar.	Austrian pine, ponderosa pine, green ash, honeylocust.	---
Be: Belfore	---	Siberian peashrub, Tatarian honeysuckle, lilac, American plum.	Eastern redcedar, hackberry, bur oak, Russian-olive, blue spruce.	Ponderosa pine, green ash, honeylocust.	---
Bn: Blendon	Skunkbush sumac	Tatarian honeysuckle, Siberian peashrub, lilac, American plum.	Honeylocust, green ash, hackberry, ponderosa pine, Russian-olive, eastern redcedar.	---	Siberian elm.
Bp: Boel	Redosier dogwood	Common chokecherry, American plum.	Eastern redcedar, hackberry.	Austrian pine, northern red oak, green ash, golden willow, honeylocust, silver maple.	Eastern cottonwood.
Br, BsC: Boelus	Skunkbush sumac	Lilac, Tatarian honeysuckle, American plum, Siberian peashrub.	Eastern redcedar, ponderosa pine, Russian-olive, green ash, honeylocust, hackberry.	---	Siberian elm.
Cf, Cg: Cass	---	Peking cotoneaster, Amur honeysuckle, lilac, American plum.	Eastern redcedar	Austrian pine, hackberry, eastern white pine, honeylocust, bur oak, green ash.	Eastern cottonwood.
CnC: Clarno	---	Siberian peashrub, American plum, lilac.	Hackberry, blue spruce, ponderosa pine, Russian-olive, Siberian crabapple, eastern redcedar.	Honeylocust, green ash.	Siberian elm.
Co: Colo	Lilac	Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, blue spruce, hackberry, ponderosa pine.	Silver maple, golden willow, honeylocust, green ash.	Eastern cottonwood.
CrC2, CrD2: Crofton	Silver buffaloberry, American plum.	Eastern redcedar, Rocky Mountain juniper, Siberian peashrub, Russian-olive, hackberry, Tatarian honeysuckle.	Ponderosa pine, honeylocust, Siberian elm, green ash.	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
CrF, CrG. Crofton					
CuE2*: Crofton	Silver buffaloberry, American plum.	Eastern redcedar, Rocky Mountain juniper, Siberian peashrub, Russian-olive, hackberry, Tatarian honeysuckle.	Ponderosa pine, honeylocust, Siberian elm, green ash.	---	---
Nora	---	Tatarian honeysuckle, Siberian peashrub, American plum, lilac.	Bur oak, hackberry, blue spruce, Russian-olive, eastern redcedar.	Honeylocust, green ash, ponderosa pine.	---
Eh, Ek. Elsmere	Lilac	Tatarian honeysuckle, common chokecherry, Siberian peashrub.	Eastern redcedar, hackberry, ponderosa pine.	Honeylocust, silver maple, golden willow, green ash.	Eastern cottonwood.
Fm. Fillmore	Redosier dogwood	Common chokecherry, American plum.	Eastern redcedar, hackberry.	Austrian pine, green ash, honeylocust, silver maple, northern red oak, golden willow.	Eastern cottonwood.
Gk. Gibbon	American plum	Common chokecherry, skunkbush sumac.	Eastern redcedar, hackberry, ponderosa pine, Russian mulberry, Manchurian crabapple.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
Gs*: Gibbon	American plum	Common chokecherry, skunkbush sumac.	Eastern redcedar, hackberry, ponderosa pine, Russian mulberry, Manchurian crabapple.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
Gayville	Lilac	Eastern redcedar, Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Siberian elm, Russian-olive, green ash.	Golden willow	Eastern cottonwood.
HaC. Hadar	Skunkbush sumac	American plum, Siberian peashrub, Tatarian honeysuckle, lilac.	Eastern redcedar, ponderosa pine, green ash, honeylocust, hackberry, Russian-olive.	---	Siberian elm.
Hd. Hobbs	---	American plum, lilac, Peking cotoneaster, Amur honeysuckle.	Eastern redcedar	Bur oak, Austrian pine, eastern white pine, green ash, hackberry, honeylocust.	Eastern cottonwood.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
He. Hobbs					
InB. Inavale	American plum.	Amur honeysuckle, lilac, fragrant sumac.	Eastern redcedar, Russian mulberry, Russian-olive.	Honeylocust, Austrian pine, hackberry, Scotch pine, green ash.	---
Ip*: Inavale	---	Eastern redcedar, Rocky Mountain juniper.	Austrian pine, ponderosa pine, jack pine.	---	---
Boel.					
La. Lamo	---	Siberian peashrub, Tatarian honeysuckle, lilac.	Hackberry, blue spruce, ponderosa pine, Manchurian crabapple, eastern redcedar.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
Lc. Lamo					
Le. Lamo	Lilac.	Tatarian honeysuckle, Siberian peashrub.	Eastern redcedar, ponderosa pine, Manchurian crabapple, blue spruce, hackberry.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
Lf. Lawet					
LgC. Libory	Tatarian honeysuckle, lilac, skunkbush sumac.	Eastern redcedar, Russian-olive, Manchurian crabapple, Siberian peashrub.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm.	---
Lo, LoC. Loretto	Skunkbush sumac.	Siberian peashrub, Tatarian honeysuckle, American plum, lilac.	Eastern redcedar, honeylocust, Russian-olive, green ash, hackberry, ponderosa pine.	---	Siberian elm.
Lp, LpC. Loretto	---	American plum, Tatarian honeysuckle, lilac, Siberian peashrub.	Eastern redcedar, blue spruce, bur oak, Russian-olive, hackberry.	Honeylocust, green ash, ponderosa pine.	---
Lt. Loup					
Ma. Marlake					
Mo, MoC, Mp. Moody	---	Siberian peashrub, American plum, Tatarian honeysuckle, lilac.	Blue spruce, hackberry, Russian-olive, bur oak, eastern redcedar.	Ponderosa pine, green ash, honeylocust.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Mu------------------ Muir	Peking cotoneaster	Amur honeysuckle, fragrant sumac, lilac.	Bur oak, eastern redcedar, hackberry, Russian-olive.	Scotch pine, honeylocust, Austrian pine, green ash.	---
NoC, NoD, NoE------ Nora	---	Tatarian honeysuckle, Siberian peashrub, American plum, lilac.	Bur oak, hackberry, blue spruce, Russian-olive, eastern redcedar.	Honeylocust, green ash, ponderosa pine.	---
NpC2*, NpD2*:					
Nora--------------	---	Siberian peashrub, American plum, Tatarian honeysuckle, lilac.	Eastern redcedar, hackberry, blue spruce, Russian-olive, bur oak.	Honeylocust, green ash, ponderosa pine.	---
Crofton-----------	Silver buffaloberry, American plum.	Eastern redcedar, Rocky Mountain juniper, Siberian peashrub, Russian-olive, hackberry, Tatarian honeysuckle.	Ponderosa pine, honeylocust, Siberian elm, green ash.	---	---
Og, Oh------------ Ord	Skunkbush sumac---	American plum, common chokecherry.	Eastern redcedar, hackberry, Russian-olive, bur oak.	Austrian pine, green ash, golden willow, honeylocust.	Eastern cottonwood.
OtC--------------- Ortello	Skunkbush sumac---	American plum, Siberian peashrub, Tatarian honeysuckle, lilac.	Eastern redcedar, honeylocust, ponderosa pine, Russian-olive, hackberry, green ash.	---	Siberian elm.
Ov---------------- Ovina	Redosier dogwood	Common chokecherry, American plum.	Eastern redcedar, hackberry, bur oak, Russian-olive.	Austrian pine, green ash, honeylocust, golden willow.	Eastern cottonwood.
Pb*: Pits.					
Dumps.					
Sm, Sn------------ Shell	---	Autumn-olive, Amur honeysuckle, Peking cotoneaster, American plum, lilac.	Eastern redcedar, bur oak.	Green ash, Austrian pine, hackberry, honeylocust.	Eastern cottonwood.
Sv---------------- Shell Variant	---	Autumn-olive, Amur honeysuckle, Peking cotoneaster, American plum, lilac.	Eastern redcedar, bur oak.	Green ash, Austrian pine, hackberry, honeylocust.	Eastern cottonwood.
ThB, ThC---------- Thurman	Amur honeysuckle, skunkbush sumac, lilac.	Eastern redcedar, Manchurian crabapple, Russian-olive, Siberian peashrub.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm------	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
ThD-------------- Thurman	---	Eastern redcedar, Rocky Mountain juniper.	Austrian pine, ponderosa pine, jack pine, Scotch pine.	---	---
Tm-------------- Thurman	Amur honeysuckle, skunkbush sumac, lilac.	Eastern redcedar, Manchurian crabapple, Russian-olive, Siberian peashrub.	Ponderosa pine, green ash, honeylocust, hackberry.	Siberian elm------	---
VaD-------------- Valentine	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
VaF-------------- Valentine	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
Zo-------------- Zook	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Honeylocust, golden willow, green ash, northern red oak, silver maple, Austrian pine.	Eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
AcC: Alcester	Slight	Slight	Moderate: slope.	Slight	Slight.
BdC: Bazile	Slight	Slight	Moderate: slope.	Slight	Slight.
Be: Belfore	Slight	Slight	Slight	Slight	Slight.
Bn: Blendon	Slight	Slight	Slight	Slight	Slight.
Bp: Boel	Severe: flooding.	Moderate: flooding, wetness.	Severe: too sandy, flooding.	Moderate: wetness, flooding.	Moderate: wetness, droughty, flooding.
Br: Boel	Severe: flooding.	Moderate: flooding, wetness.	Severe: too sandy, flooding.	Moderate: wetness, flooding.	Severe: flooding.
BsC: Boelus	Slight	Slight	Moderate: slope.	Slight	Slight.
Cf, Cg: Cass	Severe: flooding.	Slight	Slight	Slight	Slight.
CnC: Clarno	Slight	Slight	Moderate: slope.	Slight	Slight.
Co: Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
CrC2: Crofton	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
CrD2: Crofton	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
CrF: Crofton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
CrG: Crofton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
CuE2*:					
Crofton	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Nora	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Eh, Ek: Elsmere	Severe: flooding.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Fm: Fillmore	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Gk: Gibbon	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.	Moderate: wetness, flooding.
Gs*:					
Gibbon	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.	Moderate: wetness, flooding.
Gayville	Severe: flooding, excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Severe: erodes easily.	Severe: excess sodium.
HaC: Hadar	Slight	Slight	Moderate: slope.	Slight	Slight.
Hd: Hobbs	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
He: Hobbs	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
InB: Inavale	Severe: flooding.	Slight	Slight	Slight	Moderate: droughty, flooding.
Ip*:					
Inavale	Severe: flooding.	Slight	Moderate: slope.	Slight	Severe: flooding.
Boel	Severe: flooding.	Moderate: flooding, wetness.	Severe: too sandy, flooding.	Moderate: wetness, flooding.	Severe: flooding.
La: Lamo	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, flooding, percs slowly.	Moderate: wetness.	Moderate: flooding, wetness.
Lc: Lamo	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Le: Lamo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
Lf: Lawet	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
LgC: Libory	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Moderate: wetness.	Moderate: wetness, droughty.
Lo: Loretto	Slight	Slight	Slight	Slight	Slight.
LoC: Loretto	Slight	Slight	Moderate: slope.	Slight	Slight.
Lp: Loretto	Slight	Slight	Slight	Slight	Slight.
LpC: Loretto	Slight	Slight	Moderate: slope.	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Lt: Loup	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Ma: Marlake	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Mo: Moody	Slight	Slight	Slight	Slight	Slight.
MoC: Moody	Slight	Slight	Moderate: slope.	Slight	Slight.
Mp: Moody	Slight	Slight	Slight	Slight	Slight.
Mu: Muir	Slight	Slight	Slight	Slight	Slight.
NoC: Nora	Slight	Slight	Moderate: slope.	Slight	Slight.
NoD, NoE: Nora	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
NpC2*:					
Nora	Slight	Slight	Moderate: slope.	Slight	Slight.
Crofton	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
NpD2*:					
Nora	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Crofton	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
Og, Oh: Ord	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.	Moderate: wetness, flooding.
OtC: Ortello	Slight	Slight	Moderate: slope.	Slight	Slight.
Ov: Ovina	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Pb*:					
Pits.					
Dumps.					
Sm: Shell	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
Sn: Shell	Severe: flooding.	Moderate: percs slowly.	Moderate: flooding, percs slowly.	Slight	Moderate: flooding.
Sv: Shell Variant	Severe: flooding.	Moderate: percs slowly.	Moderate: flooding, percs slowly.	Slight	Moderate: flooding.
ThB, ThC: Thurman	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
ThD-------------------- Thurman	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight------------	Moderate: droughty.
Tm--------------------- Thurman	Slight----------	Slight----------	Slight----------	Slight------------	Moderate: droughty.
VaD-------------------- Valentine	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty.
VaF-------------------- Valentine	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty, slope.
Zo--------------------- Zook	Severe: wetness, flooding.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
AcC: Alcester	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
BdC: Bazile	Good	Good	Fair	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Be: Belfore	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Bn: Blendon	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Bp, Br: Boel	Fair	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Poor.
BsC: Boelus	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Cf, Cg: Cass	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
CnC: Clarno	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Co: Colo	Good	Fair	Good	Fair	Poor	Good	Good	Good	Fair	Good.
CrC2, CrD2: Crofton	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
CrF, CrG: Crofton	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
CuE2*:										
Crofton	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Nora	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Eh: Elsmere	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair.
Ek: Elsmere	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
Fm: Fillmore	Fair	Good	Fair	Fair	Fair	Good	Fair	Fair	Fair	Good.
Gk: Gibbon	Good	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair.
Gs*:										
Gibbon	Good	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair.
Gayville	Very poor.	Very poor.	Fair	Poor	Very poor.	Poor	Poor	Very poor.	Poor	Poor.
HaC: Hadar	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
Hd: Hobbs	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
He: Hobbs	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
InB: Inavale	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Ip*:										
Inavale	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Boel	Fair	Fair	Good	Good	Good	Fair	Fair	Fair	Good	Poor.
La: Lamo	Good	Good	Good	Good	Good	Fair	Fair	Good	Fair	Fair.
Lc: Lamo	Very poor.	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
Le: Lamo	Good	Good	Good	Good	Good	Fair	Fair	Good	Fair	Fair.
Lf: Lawet	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
LgC: Libory	Fair	Fair	Good	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
Lo, LoC, Lp, LpC: Loretto	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Lt: Loup	Very poor.	Poor	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
Ma: Marlake	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.
Mo, MoC: Moody	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Mp: Moody	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Mu: Muir	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.
NoC: Nora	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
NoD: Nora	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
NoE: Nora	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
NpC2*:										
Nora	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Crofton	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
NpD2*:										
Nora	Poor	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Crofton	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Og, Oh Ord	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
OtC Ortello	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Ov Ovina	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Pb*:										
Pits.										
Dumps.										
Sm, Sn Shell	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Sv Shell Variant	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
ThB, ThC Thurman	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
ThD Thurman	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Tm Thurman	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
VaD, VaF Valentine	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
Zo Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in the table indicates the dominant soil condition and does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AcC: Alcester	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
BdC: Bazile	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Severe: low strength, frost action.	Slight.
Be: Belfore	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Bn: Blendon	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
Bp: Boel	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Moderate: wetness, droughty, flooding.
Br: Boel	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.
BsC: Boelus	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Cf, Cg: Cass	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.
CnC: Clarno	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.	Slight.
Co: Colo	Severe: wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, shrink-swell, wetness.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.
CrC2: Crofton	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.	Slight.
CrD2: Crofton	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
CrF, CrG: Crofton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
CuE2*:						
Crofton	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
Nora	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
Eh, Ek: Elsmere	Severe: wetness, cutbanks cave.	Severe: flooding.	Severe: wetness, flooding.	Severe: flooding.	Moderate: wetness, frost action, flooding.	Moderate: wetness, droughty.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Fm: Fillmore	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, low strength, frost action.	Severe: ponding.
Gk: Gibbon	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.	Moderate: wetness, flooding.
Gs*:						
Gibbon	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.	Moderate: wetness, flooding.
Gayville	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Severe: excess sodium.
HaC: Hadar	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.	Slight.
Hd: Hobbs	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
He: Hobbs	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding.
InB: Inavale	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Ip*:						
Inavale	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Boel	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.
La: Lamo	Severe: wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, frost action.	Moderate: flooding, wetness.
Lc: Lamo	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness, flooding.	Severe: wetness.
Le: Lamo	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: wetness, flooding.
Lf: Lawet	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
LgC: Libory	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Moderate: wetness.	Moderate: wetness, droughty.
Lo: Loretto	Slight	Slight	Slight	Slight	Severe: low strength.	Slight.
LoC: Loretto	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Lp----------------- Loretto	Slight---------	Slight---------	Slight---------	Slight---------	Severe: low strength.	Slight.
LpC---------------- Loretto	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: low strength.	Slight.
Lt----------------- Loup	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Ma----------------- Marlake	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Mo----------------- Moody	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
MoC---------------- Moody	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
Mp----------------- Moody	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
Mu----------------- Muir	Slight---------	Slight---------	Slight---------	Slight---------	Severe: low strength.	Slight.
NoC---------------- Nora	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
NoD, NoE----------- Nora	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
NpC2*:						
Nora--------------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
Crofton-----------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: low strength.	Slight.
NpD2*:						
Nora--------------	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: frost action, low strength.	Moderate: slope.
Crofton-----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
Og, Oh------------ Ord	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.	Moderate: wetness, flooding.
OtC---------------- Ortello	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
Ov----------------- Ovina	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
Pb*:						
Pits.						
Dumps.						

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Sm, Sn: Shell	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
Sv: Shell Variant	Moderate: too clayey, wetness, flooding.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
ThB: Thurman	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
ThC: Thurman	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
ThD: Thurman	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty.
Tm: Thurman	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
VaD: Valentine	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VaF: Valentine	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Zo: Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, low strength, frost action.	Moderate: wetness, flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition and does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AcC------------------ Alcester	Slight------------	Moderate: seepage, slope.	Moderate: too clayey.	Slight------------	Fair: too clayey.
BdC------------------ Bazile	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Be------------------- Belfore	Severe: percs slowly.	Slight------------	Severe: too clayey.	Slight------------	Poor: too clayey, hard to pack.
Bn------------------- Blendon	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
Bp, Br--------------- Boel	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
BsC------------------ Boelus	Slight------------	Moderate: slope.	Slight------------	Slight------------	Good.
Cf, Cg--------------- Cass	Severe: flooding.	Severe: seepage, flooding.	Severe: seepage, flooding.	Severe: seepage, flooding.	Fair: thin layer.
CnC------------------ Clarno	Severe: percs slowly.	Moderate: slope, seepage.	Slight------------	Slight------------	Good.
Co------------------- Colo	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, flooding.	Poor: wetness, hard to pack.
CrC2----------------- Crofton	Slight------------	Moderate: seepage, slope.	Slight------------	Slight------------	Good.
CrD2----------------- Crofton	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
CrF, CrG------------- Crofton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
CuE2*:					
Crofton--------------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Nora-----------------	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Eh, Ek--------------- Elsmere	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: too sandy, seepage.
Fm------------------- Fillmore	Severe: percs slowly, ponding.	Severe: ponding.	Severe: too clayey, ponding.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Gk: Gibbon	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
Gs*:					
Gibbon	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
Gayville	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, excess sodium.	Severe: flooding, wetness.	Poor: excess sodium.
HaC: Hadar	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Severe: seepage.	Poor: hard to pack.
Hd, He: Hobbs	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
InB: Inavale	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
Ip*:					
Inavale	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: seepage, too sandy, flooding.	Severe: seepage, flooding.	Poor: too sandy, seepage.
Boel	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
La: Lamo	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack.
Lc: Lamo	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
Le: Lamo	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
Lf: Lawet	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: wetness.	Poor: wetness.
LgC: Libory	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage.	Fair: too clayey, wetness.
Lo, LoC, Lp, LpC: Loretto	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too clayey.
Lt: Loup	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ma: Marlake	Severe: ponding, poor filter.	Severe: seepage, ponding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding.	Poor: seepage, too sandy, ponding.
Mo: Moody	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
MoC: Moody	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Mp: Moody	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
Mu: Muir	Slight	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
NoC: Nora	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
NoD, NoE: Nora	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
NpC2*:					
Nora	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Crofton	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
NpD2*:					
Nora	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Crofton	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Og, Oh: Ord	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
OtC: Ortello	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Ov: Ovina	Severe: wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: wetness.
Pb*:					
Pits.					
Dumps.					
Sm, Sn: Shell	Severe: flooding.	Moderate: seepage.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Sv: Shell Variant	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
ThB, ThC------------ Thurman	Severe: poor filter.	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
ThD----------------- Thurman	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
Tm------------------ Thurman	Severe: poor filter.	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
VaD----------------- Valentine	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
VaF----------------- Valentine	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Zo------------------ Zook	Severe: percs slowly, wetness, flooding.	Severe: wetness, flooding.	Severe: wetness, too clayey, flooding.	Severe: wetness, flooding.	Poor: too clayey, wetness, hard to pack.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition and does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
AcC Alcester	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
BdC Bazile	Good	Probable	Improbable: too sandy.	Poor: area reclaim.
Be Belfore	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Bn Blendon	Good	Probable	Improbable: too sandy.	Fair: thin layer.
Bp Boel	Fair: wetness.	Probable	Improbable: too sandy.	Fair: thin layer.
Br Boel	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too sandy.
BsC Boelus	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Cf, Cg Cass	Good	Probable	Improbable: too sandy.	Good.
CnC Clarno	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Co Colo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
CrC2 Crofton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
CrD2 Crofton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
CrF Crofton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
CrG Crofton	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
CuE2*:				
Crofton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Nora	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
Eh, Ek Elsmere	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim.
Fm Fillmore	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, thin layer.
Gk Gibbon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Gs*:				
Gibbon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Gayville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
HaC Hadar	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Hd, He Hobbs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
InB Inavale	Good	Probable	Improbable: too sandy.	Fair: too sandy.
Ip*:				
Inavale	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Boel	Fair: wetness.	Probable	Improbable: too sandy.	Fair: thin layer.
La Lamo	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Lc Lamo	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Le Lamo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lf Lawet	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
LgC Libory	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Lo, LoC, Lp, LpC Loretto	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Lt Loup	Poor: wetness.	Improbable: thin layer.	Improbable: too sandy.	Poor: thin layer, wetness.
Ma Marlake	Poor: wetness.	Probable	Improbable: too sandy.	Poor: thin layer, wetness.
Mo, MoC, Mp Moody	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Mu Muir	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
NoC Nora	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
NoD, NoE Nora	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
NpC2*:				
Nora	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Crofton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
NpD2*:				
Nora	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, too clayey.
Crofton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Og, Oh Ord	Fair: wetness.	Probable	Improbable: too sandy.	Fair: thin layer.
OtC Ortello	Good	Probable	Improbable: too sandy.	Fair: thin layer.
Ov Ovina	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
Pb*:				
Pits.				
Dumps.				
Sm Shell	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Sn Shell	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Sv Shell Variant	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
ThB, ThC, ThD, Tm Thurman	Good	Probable	Improbable: too sandy.	Poor: area reclaim.
VaD Valentine	Good	Probable	Improbable: too sandy.	Poor: area reclaim, too sandy.
VaF Valentine	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Zo Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition and does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
AcC: Alcester	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
BdC: Bazile	Severe: seepage.	Severe: seepage, piping.	Deep to water	Rooting depth, slope.	Too sandy	Rooting depth.
Be: Belfore	Slight	Moderate: hard to pack.	Deep to water	Favorable	Favorable	Favorable.
Bn: Blendon	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing	Too sandy, soil blowing.	Favorable.
Bp: Boel	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
Br: Boel	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
BsC: Boelus	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, fast intake, soil blowing.	Erodes easily, soil blowing.	Erodes easily.
Cf: Cass	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Soil blowing	Favorable.
Cg: Cass	Severe: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
CnC: Clarno	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
Co: Colo	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Flooding, wetness.	Wetness	Wetness.
CrC2: Crofton	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
CrD2, CrF, CrG: Crofton	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
CuE2*:						
Crofton	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Nora	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Eh, Ek: Elsmere	Severe: seepage.	Severe: seepage, piping, wetness.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty.
Fm: Fillmore	Moderate: seepage.	Severe: hard to pack, ponding.	Percs slowly, frost action, ponding.	Percs slowly, ponding.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Gk: Gibbon	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Favorable.
Gs*:						
Gibbon	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Favorable.
Gayville	Moderate: seepage.	Severe: piping, excess sodium.	Percs slowly, flooding, excess salt.	Wetness, percs slowly, excess sodium.	Erodes easily, wetness.	Excess sodium, erodes easily, percs slowly.
HaC: Hadar	Severe: seepage.	Moderate: piping, hard to pack.	Deep to water	Fast intake, soil blowing.	Soil blowing	Rooting depth.
Hd, He: Hobbs	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
InB: Inavale	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Ip*:						
Inavale	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Boel	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty.	Wetness, too sandy, soil blowing.	Droughty, rooting depth.
La: Lamo	Slight	Moderate: piping, hard to pack, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Favorable.
Lc: Lamo	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
Le: Lamo	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
Lf: Lawet	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
LgC: Libory	Severe: seepage.	Severe: piping.	Slope	Wetness, droughty, fast intake.	Erodes easily, wetness, soil blowing.	Erodes easily, droughty, rooting depth.
Lo: Loretto	Severe: seepage.	Moderate: piping.	Deep to water	Favorable	Soil blowing	Favorable.
LoC: Loretto	Severe: seepage.	Moderate: piping.	Deep to water	Slope	Soil blowing	Favorable.
Lp: Loretto	Severe: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
LpC: Loretto	Severe: seepage.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
Lt: Loup	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty, fast intake.	Ponding, too sandy.	Wetness, droughty.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ma----------------- Marlake	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, cutbanks cave.	Ponding, droughty.	Ponding, too sandy, soil blowing.	Wetness, droughty.
Mo----------------- Moody	Moderate: seepage.	Moderate: thin layer, piping, hard to pack.	Deep to water	Favorable------	Erodes easily	Erodes easily.
MoC---------------- Moody	Moderate: seepage, slope.	Moderate: thin layer, piping, hard to pack.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Mp----------------- Moody	Moderate: seepage.	Moderate: thin layer, piping, hard to pack.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Mu----------------- Muir	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
NoC---------------- Nora	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
NoD, NoE----------- Nora	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
NpC2*:						
Nora---------------	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
Crofton------------	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
NpD2*:						
Nora---------------	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Crofton------------	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Og----------------- Ord	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness--------	Wetness, too sandy, soil blowing.	Rooting depth.
Oh----------------- Ord	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Rooting depth.
OtC---------------- Ortello	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope----------	Too sandy, soil blowing.	Favorable.
Ov----------------- Ovina	Severe: seepage.	Severe: piping, wetness.	Frost action---	Wetness--------	Wetness, soil blowing.	Wetness.
Pb*:						
Pits.						
Dumps.						

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Sm, Sn: Shell	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
Sv: Shell Variant	Moderate: seepage.	Severe: hard to pack.	Percs slowly, flooding.	Wetness, percs slowly, flooding.	Wetness, percs slowly.	Percs slowly.
ThB, ThC: Thurman	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
ThD: Thurman	Severe: slope, seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Droughty, slope.
Tm: Thurman	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
VaD: Valentine	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty, rooting depth.
VaF: Valentine	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Zo: Zook	Slight	Severe: hard to pack, wetness.	Flooding, percs slowly, frost action.	Wetness, percs slowly.	Not needed	Not needed.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
AcC------------- Alcester	0-7	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	90-100	35-50	10-25
	7-48	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	100	100	95-100	90-100	35-50	10-25
	48-60	Silty clay loam, silt loam.	ML, CL	A-6, A-7	0	100	95-100	95-100	85-100	30-50	10-20
BdC------------- Bazile	0-11	Loam-------------	ML, CL	A-4, A-6	0	100	100	90-100	65-95	25-40	3-15
	11-24	Silty clay loam, silt loam, clay loam.	CL	A-6, A-7	0	100	100	90-100	85-95	35-45	15-25
	24-60	Sand, loamy fine sand, fine sand.	SP-SM, SP, SM	A-2, A-3	0	100	100	50-90	2-15	<20	NP
Be-------------- Belfore	0-13	Silty clay loam	CL, CH	A-6, A-7	0	100	100	100	95-100	35-55	15-30
	13-48	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	100	95-100	45-60	20-30
	48-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	35-55	15-30
Bn-------------- Blendon	0-10	Fine sandy loam	SM	A-4	0	100	90-100	60-100	35-50	20-30	NP-5
	10-28	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-4, A-2	0	100	85-100	60-100	20-60	20-33	NP-10
	28-60	Fine sandy loam, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-4	0	85-100	65-100	50-100	10-45	<30	NP-5
Bp-------------- Boel	0-15	Fine sandy loam	SM	A-4, A-2	0	100	100	85-95	20-40	<20	NP
	15-60	Fine sand, loamy fine sand, coarse sand.	SP, SM	A-2, A-3	0	100	95-100	85-95	0-25	---	NP
Br-------------- Boel	0-13	Loamy fine sand	SM, SP	A-2, A-3	0	100	95-100	85-95	0-35	---	NP
	13-26	Fine sand, loamy fine sand, coarse sand.	SP, SM	A-2, A-3	0	100	95-100	85-95	0-25	---	NP
BsC------------- Boelus	0-7	Loamy fine sand	SM, SP-SM	A-2	0	100	100	50-100	10-35	<20	NP
	7-24	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-2	0	100	100	50-100	10-35	<20	NP
	24-50	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	100	100	90-100	80-100	30-40	8-15
	50-60	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	100	100	90-100	80-100	30-40	8-18
Cf-------------- Cass	0-19	Fine sandy loam	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-40	<20	NP-5
	19-28	Fine sandy loam, sandy loam, very fine sandy loam.	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-50	<20	NP-5
	28-60	Loamy fine sand, fine sand, coarse sand.	SM, SP-SM	A-2, A-3	0	95-100	95-100	50-75	5-30	---	NP
Cg-------------- Cass	0-8	Loam-------------	CL-ML, CL	A-4, A-6	0	95-100	95-100	85-95	60-75	25-40	5-15
	8-26	Fine sandy loam, sandy loam, very fine sandy loam.	SM, SM-SC	A-4, A-2	0	100	95-100	85-95	20-50	<20	NP-5
	26-60	Loamy fine sand, fine sand, coarse sand.	SM, SP-SM	A-2, A-3	0	95-100	95-100	50-75	5-30	---	NP
CnC------------- Clarno	0-12	Loam-------------	CL, CL-ML, ML	A-4, A-6	0	100	95-100	85-100	55-90	25-40	5-20
	12-36	Loam, clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-100	55-85	30-45	10-20
	36-60	Loam, clay loam	CL	A-6, A-7	0-5	90-100	90-100	80-100	50-80	30-45	10-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Co-------------- Colo	0-20	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	20-44	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
	44-60	Silty clay loam, clay loam, silt loam.	CL, CH, ML	A-6, A-7	0	100	100	95-100	80-100	35-55	15-30
CrC2, CrD2, CrF, CrG------------- Crofton	0-5	Silt loam--------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	5-60	Silt loam--------	CL	A-6, A-7	0	100	95-100	95-100	95-100	32-50	10-25
CuE2*: Crofton---------	0-5	Silt loam--------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	5-60	Silt loam--------	CL	A-6, A-7	0	100	95-100	95-100	95-100	32-50	10-25
Nora------------	0-5	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	12-25
	5-24	Silt loam, silty clay loam.	CL, ML	A-6, A-7	0	95-100	95-100	95-100	85-100	35-50	11-20
	24-60	Silt loam, silty clay loam.	CL, CL-ML, ML	A-4, A-6, A-7	0	95-100	95-100	95-100	85-100	27-50	6-20
Eh--------------- Elsmere	0-16	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	100	70-100	5-35	---	NP
	16-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	100	60-100	5-30	---	NP
Ek--------------- Elsmere	0-13	Fine sandy loam	SM, SM-SC	A-4, A-2	0	100	100	70-100	30-50	<25	NP-5
	13-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-2, A-3	0	100	100	60-100	5-30	---	NP
Fm--------------- Fillmore	0-15	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	100	95-100	20-40	2-20
	15-29	Silty clay, clay	CH, CL	A-7	0	100	100	100	95-100	40-75	20-45
	29-52	Silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	100	100	95-100	35-60	20-40
	52-60	Silt loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	100	95-100	25-75	10-45
Gk--------------- Gibbon	0-19	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	85-100	35-55	20-35
	19-42	Silt loam, clay loam.	CL	A-6	0	100	100	90-100	55-90	25-38	12-20
	42-60	Stratified fine sandy loam to silt loam.	SM, SC, CL, ML	A-4	0	100	100	70-95	35-90	<25	NP-8
Gs*: Gibbon----------	0-15	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	70-100	35-55	20-35
	15-20	Silt loam, loam	CL	A-6	0	100	95-100	90-100	55-90	25-38	12-25
	20-60	Stratified fine sandy loam to silt loam.	SM, SC, CL, ML	A-4	0	95-100	95-100	70-95	35-90	<25	NP-8
Gayville--------	0-1	Silty clay loam	CL, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	30-45	5-20
	1-10	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	85-100	35-50	12-25
	10-29	Silty clay loam, clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	85-100	30-45	8-20
	29-60	Loam, silt loam, silty clay loam.	ML, CL	A-4, A-6	0	100	100	95-100	65-80	25-40	3-15
HaC-------------- Hadar	0-14	Loamy fine sand	SM	A-2	0	100	100	80-95	15-35	---	NP
	14-24	Loamy fine sand, sand, loamy sand.	SM, SP-SM	A-2, A-3, A-4	0	100	100	50-95	5-40	---	NP
	24-60	Loam, clay loam, sandy clay loam.	CL, CH, SC	A-6, A-7	0	95-100	95-100	80-95	35-75	25-55	10-30

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Hd, He----------- Hobbs	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	8-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	80-100	25-50	5-25
InB-------------- Inavale	0-7	Loamy fine sand	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	85-95	5-35	<25	NP-5
	7-15	Fine sand, loamy sand, loamy fine sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	15-60	Fine sand, loamy sand, loamy fine sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5
Ip*: Inavale---------	0-8	Loamy fine sand	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	85-95	5-35	<25	NP-5
	8-12	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	12-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5
Boel------------	0-14	Loam, fine sandy loam.	SM	A-4, A-2	0	100	100	85-95	20-40	<20	NP
	14-60	Fine sand, loamy fine sand, coarse sand.	SP, SM	A-2, A-3	0	100	95-100	85-95	0-25	---	NP
La--------------- Lamo	0-20	Silty clay loam	CL, CH, ML, MH	A-7	0	100	100	95-100	85-95	40-65	14-35
	20-60	Silty clay loam, silt loam.	CL, CH	A-7, A-6	0	100	100	95-100	85-95	30-55	11-35
Lc--------------- Lamo	0-16	Silty clay loam	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-55	15-35
	16-60	Silty clay loam	CL, CH	A-7, A-6	0	100	100	95-100	85-95	35-55	15-35
Le--------------- Lamo	0-18	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-25	20-35	3-12
	18-60	Silt loam, silty clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-95	20-35	3-12
Lf--------------- Lawet	0-26	Loam-------------	CL, CL-ML	A-6, A-4	0	100	100	85-100	50-95	20-40	5-15
	26-46	Sandy clay loam, loam, silty clay loam.	CL, SC	A-6, A-4	0	100	100	70-100	35-75	20-35	8-20
	46-60	Stratified fine sandy loam to fine sand.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	100	60-100	20-60	<20	NP-5
LgC-------------- Libory	0-14	Loamy fine sand	SM	A-2, A-4	0	100	100	65-85	15-45	---	NP
	14-24	Loamy fine sand, loamy sand, fine sand.	SM, SP-SM	A-2	0	100	100	55-80	12-35	---	NP
	24-60	Silty clay loam, silt loam, very fine sandy loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-95	20-40	4-24
Lo, LoC---------- Loretto	0-16	Fine sandy loam	SM, SM-SC	A-2, A-4	0	100	100	70-100	20-40	<25	NP-5
	16-52	Loam, silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	85-100	80-100	30-45	11-25
	52-60	Loam, silt loam, silty clay loam.	CL	A-6, A-7, A-4	0	100	100	80-100	80-100	30-47	8-25
Lp, LpC---------- Loretto	0-12	Loam-------------	CL, CL-ML	A-6, A-4	0	100	100	85-100	60-90	25-40	5-15
	12-37	Loam, silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	85-100	80-100	30-45	11-25
	37-60	Loam, silt loam, silty clay loam.	CL	A-6, A-7, A-4	0	100	100	80-100	80-100	30-47	8-25

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Lt----------------- Loup	0-19	Loamy fine sand	SM	A-2	0	100	100	50-100	15-30	---	NP
	19-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	65-100	5-20	---	NP
Ma----------------- Marlake	0-7	Loam-------------	SM, ML	A-4	0	100	100	70-85	40-55	<20	NP
	7-17	Fine sand, loamy sand, loamy fine sand.	SP-SM, SM	A-2, A-4, A-3	0	100	100	50-85	5-50	---	NP
	17-60	Sand, fine sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	100	50-80	5-35	---	NP
Mo, MoC, Mp------ Moody	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	13-25
	7-39	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	95-100	85-100	32-55	11-33
	39-60	Silt loam, silty clay loam.	CL, CL-ML, ML	A-4, A-6, A-7	0	100	100	95-100	85-100	25-45	3-20
Mu----------------- Muir	0-46	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	85-100	35-45	15-25
	46-60	Silt loam, silty clay loam, loam.	CL, ML, CL-ML	A-4, A-6, A-7-6	0	100	100	95-100	85-100	20-45	4-20
NoC, NoD, NoE---- Nora	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	12-25
	7-20	Silt loam, silty clay loam.	CL, ML	A-6, A-7	0	95-100	95-100	95-100	85-100	35-50	11-20
	20-60	Silt loam, silty clay loam.	CL, CL-ML, ML	A-4, A-6, A-7	0	95-100	95-100	95-100	85-100	27-50	6-20
NpC2*, NpD2*:											
Nora-------------	0-5	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	12-25
	5-16	Silt loam, silty clay loam.	CL, ML	A-6, A-7	0	95-100	95-100	95-100	85-100	35-50	11-20
	16-60	Silt loam, silty clay loam.	CL, CL-ML, ML	A-4, A-6, A-7	0	95-100	95-100	95-100	85-100	27-50	6-20
Crofton----------	0-5	Silt loam--------	ML, CL	A-6, A-7	0	100	100	95-100	95-100	35-50	10-25
	5-60	Silt loam--------	CL	A-6, A-7	0	100	95-100	95-100	95-100	32-50	10-25
Og----------------- Ord	0-18	Fine sandy loam	ML, SM	A-2, A-4	0	95-100	95-100	70-98	30-90	20-35	NP-10
	18-32	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-2, A-4	0	95-100	95-100	70-100	30-85	20-35	NP-10
	32-60	Stratified sand to loamy fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	95-100	95-100	50-100	5-30	<20	NP-5
Oh----------------- Ord	0-7	Loam-------------	ML, CL	A-4, A-6	0	100	100	95-100	55-100	25-35	2-15
	7-32	Fine sandy loam, loamy fine sand, sandy loam.	SM, ML	A-2, A-4	0	95-100	95-100	70-100	30-85	20-35	NP-10
	32-60	Stratified sand to loamy fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	95-100	95-100	50-100	5-30	<20	NP-5
OtC---------------- Ortello	0-15	Fine sandy loam	SM, ML	A-4	0	100	100	70-95	40-55	<20	NP
	15-30	Fine sandy loam, sandy loam.	SM, ML	A-4	0	100	100	70-95	40-55	<20	NP
	30-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-3, A-2	0	100	100	50-70	5-35	---	NP

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Ov---------------- Ovina	0-17	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-60	---	NP
	17-41	Fine sandy loam, loam.	SM, ML	A-4	0	100	100	70-85	40-60	---	NP
	41-60	Fine sandy loam, very fine sandy loam.	SM, ML	A-4	0	100	100	70-85	40-60	---	NP
Pb*: Pits.											
Dumps.											
Sm---------------- Shell	0-20	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	95-100	90-100	25-40	6-18
	20-44	Silt loam, silty clay loam, loam.	CL	A-6	0	100	100	95-100	90-100	25-40	10-25
	44-60	Silt loam, loam, silty clay loam.	CL	A-6	0	100	100	95-100	90-100	25-40	10-25
Sn---------------- Shell	0-26	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	30-45	12-25
	26-35	Silt loam, silty clay loam, loam.	CL	A-6	0	100	100	95-100	90-100	25-40	10-25
	35-60	Silt loam, loam, silty clay loam.	CL	A-6	0	100	100	95-100	90-100	25-40	10-25
Sv---------------- Shell Variant	0-16	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	12-25
	16-28	Silty clay loam	CL	A-6	0	100	100	95-100	90-100	25-40	12-25
	28-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-70	27-45
ThB, ThC, ThD---- Thurman	0-12	Loamy fine sand	SM, SP-SM	A-2, A-3, A-4	0	100	100	90-100	5-40	<20	NP
	12-60	Loamy fine sand, fine sand, very fine sand.	SM, SP-SM	A-2, A-3	0	100	100	85-100	5-25	---	NP
Tm---------------- Thurman	0-18	Loamy fine sand	SM, SP-SM	A-2, A-3, A-4	0	100	100	90-100	5-40	<20	NP
	18-60	Loamy fine sand, fine sand, very fine sand.	SM, SP-SM	A-2, A-3	0	100	100	85-100	5-25	---	NP
VaD, VaF---------- Valentine	0-6	Fine sand---------	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
	6-60	Fine sand, loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-20	---	NP
Zo---------------- Zook	0-13	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	13-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH	Mmhos/cm					Pct
AcC--------------- Alcester	0-7	27-32	1.20-1.35	0.6-2.0	0.19-0.22	5.6-7.8	<2	Moderate	0.28	5	7	2-4
	7-48	20-32	1.20-1.35	0.6-2.0	0.19-0.22	6.1-7.8	<2	Moderate	0.28			
	48-60	20-32	1.30-1.45	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
BdC--------------- Bazile	0-11	17-27	1.35-1.45	0.6-2.0	0.20-0.24	5.1-6.5	<2	Low--------	0.32	4	6	2-4
	11-24	22-35	1.25-1.35	0.2-0.6	0.18-0.22	5.6-7.8	<2	Moderate	0.32			
	24-60	2-10	1.70-1.90	6.0-20	0.05-0.07	6.1-8.4	<2	Low--------	0.15			
Be---------------- Belfore	0-13	25-39	1.30-1.50	0.2-0.6	0.21-0.24	5.6-6.5	<2	High-------	0.32	5	7	2-4
	13-48	37-43	1.20-1.40	0.2-0.6	0.11-0.18	5.6-7.8	<2	High-------	0.32			
	48-60	25-35	1.30-1.50	0.2-0.6	0.18-0.22	6.1-8.4	<2	High-------	0.32			
Bn---------------- Blendon	0-10	10-18	1.25-1.35	2.0-6.0	0.11-0.17	5.6-7.3	<2	Low--------	0.20	5	3	2-4
	10-28	10-20	1.20-1.30	2.0-6.0	0.11-0.18	6.1-7.3	<2	Low--------	0.20			
	28-60	5-18	1.30-1.45	2.0-20	0.08-0.15	6.6-8.4	<2	Low--------	0.20			
Bp---------------- Boel	0-15	8-18	1.50-1.70	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low--------	0.20	5	3	1-2
	15-60	0-6	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low--------	0.20			
Br---------------- Boel	0-13	2-10	1.60-1.80	6.0-20	0.10-0.12	6.6-8.4	<2	Low--------	0.17	5	2	.5-1
	13-26	0-6	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low--------	0.20			
BsC--------------- Boelus	0-7	2-12	1.70-1.90	6.0-20	0.10-0.12	5.6-7.3	<2	Low--------	0.17	5	2	1-2
	7-24	2-12	1.70-1.90	6.0-20	0.09-0.11	6.1-7.8	<2	Low--------	0.17			
	24-50	15-35	1.40-1.60	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.43			
	50-60	15-35	1.30-1.50	0.6-2.0	0.17-0.22	6.1-8.4	<2	Moderate	0.43			
Cf---------------- Cass	0-19	7-17	1.40-1.60	2.0-6.0	0.16-0.18	5.6-7.3	<2	Low--------	0.20	5	3	1-2
	19-28	5-15	1.40-1.60	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low--------	0.20			
	28-60	2-10	1.50-1.70	6.0-20	0.08-0.10	6.1-8.4	<2	Low--------	0.20			
Cg---------------- Cass	0-8	10-20	1.20-1.40	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low--------	0.28	5	5	2-4
	8-26	5-15	1.40-1.60	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low--------	0.20			
	26-60	2-10	1.50-1.70	6.0-20	0.08-0.10	6.1-8.4	<2	Low--------	0.20			
CnC--------------- Clarno	0-12	20-27	1.20-1.30	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low--------	0.28	5	6	1-2
	12-36	20-30	1.25-1.40	0.6-2.0	0.16-0.20	6.6-8.4	<2	Moderate	0.37			
	36-60	20-30	1.50-1.70	0.2-0.6	0.16-0.20	7.4-9.0	2-8	Moderate	0.37			
Co---------------- Colo	0-20	27-32	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	<2	High-------	0.28	5	7	5-7
	20-44	30-35	1.25-1.35	0.6-2.0	0.18-0.20	6.1-7.3	<2	High-------	0.28			
	44-60	30-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	<2	High-------	0.28			
CrC2, CrD2, CrF, CrG--------------- Crofton	0-5	20-27	1.20-1.30	0.6-2.0	0.21-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	.5-2
	5-60	15-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
CuE2*: Crofton----------	0-5	20-27	1.20-1.30	0.6-2.0	0.21-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	.5-1
	5-60	15-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
Nora-------------	0-5	27-35	1.20-1.25	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	5	7	1-2
	5-24	20-35	1.25-1.35	0.6-2.0	0.17-0.20	6.1-7.3	<2	Moderate	0.43			
	24-60	18-30	1.30-1.45	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
Eh---------------- Elsmere	0-16	3-10	1.90-2.10	6.0-20	0.10-0.12	5.6-8.4	<2	Low--------	0.17	5	2	1-2
	16-60	0-8	1.90-2.10	6.0-20	0.06-0.11	5.6-8.4	<2	Low--------	0.17			
Ek---------------- Elsmere	0-13	5-15	1.70-1.90	2.0-6.0	0.13-0.18	5.6-8.4	<2	Low--------	0.20	5	3	1-2
	13-60	0-8	1.90-2.10	6.0-20	0.06-0.11	5.6-8.4	<2	Low--------	0.17			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
Fm---------------- Fillmore	0-15	18-35	1.30-1.40	0.6-2.0	0.21-0.24	5.6-6.5	<2	Moderate	0.37	4	6	2-4
	15-29	40-55	1.30-1.50	<0.06	0.11-0.14	5.6-7.8	<2	High------	0.37			
	29-52	32-40	1.20-1.40	0.2-0.6	0.18-0.20	6.6-8.4	<2	High------	0.37			
	52-60	18-45	1.30-1.50	0.06-2.0	0.10-0.22	6.6-8.4	<2	Moderate	0.37			
Gk---------------- Gibbon	0-19	27-35	1.25-1.35	0.2-0.6	0.21-0.23	7.4-8.4	<2	Moderate	0.32	5	4L	2-4
	19-42	20-27	1.30-1.50	0.6-2.0	0.18-0.22	7.9-8.4	<2	Moderate	0.32			
	42-60	15-25	1.50-1.70	0.6-6.0	0.16-0.20	7.9-9.0	<2	Low-------	0.32			
Gs*:												
Gibbon-----------	0-15	27-35	1.25-1.35	0.2-0.6	0.21-0.23	7.4-8.4	<2	Moderate	0.32	5	4L	2-4
	15-20	20-27	1.30-1.50	0.6-2.0	0.18-0.22	7.9-8.4	<2	Moderate	0.32			
	20-60	15-25	1.50-1.70	0.6-6.0	0.16-0.20	7.9-9.0	<2	Low-------	0.32			
Gayville---------	0-1	27-35	1.25-1.30	0.6-2.0	0.16-0.19	7.4-9.0	2-4	Moderate	0.37	1	7	2-4
	1-10	35-45	1.35-1.45	<0.06	0.10-0.16	7.9-9.0	4-16	High------	0.37			
	10-29	27-35	1.30-1.40	0.2-0.6	0.14-0.16	>7.8	4-16	High------	0.37			
	29-60	20-35	1.30-1.40	0.2-2.0	0.16-0.18	>7.8	4-16	Low-------	0.37			
HaC--------------- Hadar	0-14	4-12	1.50-1.70	6.0-20	0.10-0.12	5.6-6.5	<2	Low-------	0.17	5	2	1-2
	14-24	4-12	1.50-1.90	6.0-20	0.06-0.11	5.6-6.5	<2	Low-------	0.17			
	24-60	20-35	1.25-1.40	0.2-0.6	0.14-0.18	6.6-8.4	<2	Moderate	0.32			
Hd, He----------- Hobbs	0-8	15-30	1.20-1.40	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low-------	0.32	5	6	2-4
	8-60	15-30	1.20-1.40	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low-------	0.32			
InB--------------- Inavale	0-7	2-10	1.50-1.60	6.0-20	0.10-0.12	6.6-7.8	<2	Low-------	0.17	5	2	.5-1
	7-15	3-10	1.50-1.60	6.0-20	0.06-0.11	6.6-8.4	<2	Low-------	0.17			
	15-60	3-10	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low-------	0.17			
Ip*:												
Inavale----------	0-8	7-18	1.50-1.60	6.0-20	0.10-0.12	6.6-7.8	<2	Low-------	0.17	5	2	.5-1
	8-12	3-10	1.50-1.60	6.0-20	0.06-0.11	6.6-8.4	<2	Low-------	0.17			
	12-60	3-10	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low-------	0.17			
Boel-------------	0-14	8-18	1.50-1.70	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low-------	0.20	5	3	1-2
	14-60	0-6	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low-------	0.20			
La---------------- Lamo	0-20	27-35	1.40-1.60	0.2-0.6	0.21-0.23	7.4-8.4	<2	High------	0.32	5	7	2-4
	20-60	25-35	1.30-1.50	0.2-0.6	0.18-0.22	7.4-8.4	<2	High------	0.32			
Lc---------------- Lamo	0-16	27-35	1.20-1.35	0.2-0.6	0.18-0.20	7.4-8.4	<2	High------	0.32	5	4L	2-4
	16-60	27-35	1.20-1.35	0.2-0.6	0.18-0.20	7.4-8.4	<2	High------	0.32			
Le---------------- Lamo	0-18	20-32	1.20-1.30	0.6-2.0	0.21-0.23	7.4-8.4	<2	Low-------	0.28	5	4L	8-15
	18-60	20-32	1.25-1.35	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low-------	0.28			
Lf---------------- Lawet	0-26	15-25	1.30-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-------	0.28	5	4L	4-6
	26-46	22-35	1.30-1.50	0.6-2.0	0.14-0.19	7.4-9.0	<2	Moderate	0.28			
	46-60	0-15	1.50-1.80	2.0-20	0.05-0.13	6.6-8.4	<2	Low-------	0.17			
LgC--------------- Libory	0-14	2-12	1.60-1.80	6.0-20	0.07-0.12	5.6-7.3	<2	Low-------	0.17	5	2	1-2
	14-24	2-12	1.60-1.80	6.0-20	0.06-0.11	5.6-7.3	<2	Low-------	0.17			
	24-60	15-32	1.20-1.40	0.6-2.0	0.17-0.22	5.6-7.8	<2	Low-------	0.43			
Lo, LoC---------- Loretto	0-16	8-18	1.40-1.60	2.0-6.0	0.13-0.18	5.1-6.5	<2	Low-------	0.20	5	3	1-2
	16-52	20-35	1.30-1.40	0.6-6.0	0.17-0.20	5.6-7.3	<2	Low-------	0.28			
	52-60	18-30	1.40-1.50	0.6-6.0	0.17-0.20	6.1-8.4	<2	Low-------	0.28			
Lp, LpC---------- Loretto	0-12	10-20	1.30-1.50	0.6-2.0	0.20-0.22	5.1-6.5	<2	Low-------	0.28	5	6	2-4
	12-37	20-35	1.30-1.40	0.6-6.0	0.17-0.20	5.6-7.3	<2	Low-------	0.28			
	37-60	18-30	1.40-1.50	0.6-6.0	0.17-0.20	6.1-8.4	<2	Low-------	0.28			
Lt---------------- Loup	0-19	5-10	1.40-1.60	6.0-20	0.10-0.14	6.6-8.4	<2	Low-------	0.17	5	8	4-8
	19-60	2-7	1.50-1.70	6.0-20	0.06-0.08	6.6-8.4	<2	Low-------	0.17			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
Ma----------------- Marlake	0-7	5-15	1.40-1.50	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low--------	0.20	2	8	4-8
	7-17	3-8	1.50-1.60	6.0-20	0.06-0.11	6.6-8.4	<2	Low--------	0.17			
	17-60	0-5	1.50-1.60	6.0-20	0.05-0.07	6.6-7.8	<2	Low--------	0.17			
Mo, MoC, Mp------- Moody	0-7	27-35	1.25-1.30	0.2-2.0	0.19-0.22	5.6-7.3	<2	Moderate	0.32	5	7	2-4
	7-39	24-35	1.20-1.30	0.2-0.6	0.17-0.20	6.1-7.8	<2	Moderate	0.43			
	39-60	20-30	1.30-1.45	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
Mu----------------- Muir	0-46	28-35	1.30-1.45	0.6-2.0	0.21-0.23	5.6-7.8	<2	Moderate	0.32	5	7	2-4
	46-60	18-35	1.30-1.50	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low--------	0.32			
NoC, NoD, NoE----- Nora	0-7	27-35	1.20-1.25	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	5	7	2-4
	7-20	20-35	1.25-1.35	0.6-2.0	0.17-0.20	6.1-7.3	<2	Moderate	0.43			
	20-60	18-30	1.30-1.45	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
NpC2*:												
Nora-------------	0-4	27-35	1.20-1.25	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	5	7	1-2
	4-16	20-35	1.25-1.35	0.6-2.0	0.17-0.20	6.1-7.3	<2	Moderate	0.43			
	16-60	18-30	1.30-1.45	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
Crofton----------	0-4	20-27	1.20-1.30	0.6-2.0	0.21-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	.5-1
	4-60	15-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
NpD2*:												
Nora-------------	0-4	27-35	1.20-1.25	0.6-2.0	0.19-0.22	6.1-7.3	<2	Moderate	0.32	5	7	1-2
	4-16	20-35	1.25-1.35	0.6-2.0	0.17-0.20	6.1-7.3	<2	Moderate	0.43			
	16-60	18-30	1.30-1.45	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.43			
Crofton----------	0-5	20-27	1.20-1.30	0.6-2.0	0.21-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	.5-1
	5-60	15-27	1.10-1.20	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.43			
Og----------------- Ord	0-18	8-15	1.40-1.60	0.6-6.0	0.16-0.24	7.4-8.4	<2	Low--------	0.20	5	3	1-2
	18-32	8-15	1.50-1.70	2.0-6.0	0.15-0.17	6.6-8.4	<2	Low--------	0.20			
	32-60	3-12	1.60-1.80	2.0-20	0.02-0.04	6.6-8.4	<2	Low--------	0.20			
Oh----------------- Ord	0-16	8-15	1.40-1.60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.24	5	5	1-2
	16-24	8-15	1.50-1.70	2.0-6.0	0.15-0.17	6.6-8.4	<2	Low--------	0.20			
	24-60	3-12	1.60-1.80	2.0-20	0.02-0.04	6.6-8.4	<2	Low--------	0.20			
OtC---------------- Ortello	0-15	5-15	1.40-1.60	2.0-6.0	0.13-0.18	6.1-7.3	<2	Low--------	0.20	5	3	1-2
	15-30	5-15	1.40-1.60	2.0-6.0	0.12-0.17	6.1-7.3	<2	Low--------	0.20			
	30-60	2-10	1.50-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.15			
Ov----------------- Ovina	0-17	8-18	1.30-1.50	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low--------	0.20	5	3	2-3
	17-41	8-18	1.30-1.50	0.6-2.0	0.15-0.17	6.6-8.4	<2	Low--------	0.17			
	41-60	5-15	1.40-1.60	2.0-6.0	0.14-0.16	7.4-8.4	<2	Low--------	0.20			
Pb*:												
Pits.												
Dumps.												
Sm----------------- Shell	0-20	15-27	1.20-1.30	0.6-2.0	0.22-0.24	5.6-7.3	<2	Low--------	0.32	5	6	2-4
	20-44	20-30	1.20-1.30	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low--------	0.32			
	44-60	20-30	1.20-1.30	0.6-2.0	0.20-0.22	6.1-7.8	<2	Low--------	0.32			
Sn----------------- Shell	0-26	27-32	1.15-1.25	0.2-0.6	0.21-0.23	5.6-7.3	<2	Moderate	0.32	5	7	2-4
	26-35	20-30	1.20-1.30	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low--------	0.32			
	35-60	20-30	1.20-1.30	0.6-2.0	0.20-0.22	6.1-7.8	<2	Low--------	0.32			
Sv----------------- Shell Variant	0-16	27-35	1.20-1.30	0.6-2.0	0.21-0.23	6.1-7.3	<2	Moderate	0.32	5	7	2-4
	16-28	27-35	1.15-1.25	0.6-2.0	0.18-0.20	6.1-7.3	<2	Moderate	0.32			
	28-60	35-55	1.15-1.30	0.06-0.2	0.10-0.13	6.6-8.4	<2	High-------	0.32			
ThB, ThC, ThD----- Thurman	0-12	5-12	1.60-1.80	6.0-20	0.10-0.12	6.1-7.3	<2	Low--------	0.17	5	2	1-2
	12-60	2-10	1.60-1.80	6.0-20	0.06-0.11	6.1-7.3	<2	Low--------	0.17			
Tm----------------- Thurman	0-18	5-12	1.60-1.80	6.0-20	0.10-0.12	6.1-7.3	<2	Low--------	0.17	5	2	1-2
	18-60	2-10	1.60-1.80	6.0-20	0.06-0.11	6.1-7.3	<2	Low--------	0.17			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH	Mmhos/cm					Pct
VaD, VaF--------- Valentine	0-6 6-60	0-6 0-8	1.70-1.90 1.70-1.90	6.0-20 6.0-20	0.07-0.09 0.05-0.11	5.6-7.3 5.6-7.3	<2 <2	Low-------- Low--------	0.15 0.15	5	1	.5-1
Zo--------------- Zook	0-13 13-60	32-38 36-45	1.30-1.35 1.30-1.45	0.2-0.6 0.06-0.2	0.21-0.23 0.11-0.13	5.6-7.3 5.6-7.8	<2 <2	High------- High-------	0.28 0.28	5	7	5-7

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
AcC-----Alcester	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Low.
BdC-----Bazile	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Low-----	Low.
Be-----Belfore	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Bn-----Blendon	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Bp-----Boel	A	Occasional	Brief-----	Mar-Jun	1.5-3.5	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
Br-----Boel	A	Frequent-----	Brief-----	Mar-Jun	0.5-2.5	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
BsC-----Boelus	A	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Cf, Cg-----Cass	B	Occasional	Brief-----	Mar-Jun	>6.0	---	---	>60	---	Moderate	Moderate	Low.
CnC-----Clarno	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
Co-----Colo	B/D	Occasional	Very brief to long.	Feb-Nov	2.0-3.0	Apparent	Nov-Jul	>60	---	High-----	High-----	Moderate.
CrC2, CrD2, CrF, CrG-----Crofton	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Low.
CuE2*:												
Crofton-----	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Nora-----	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Low.
Eh, Ek-----Elsmere	A	Rare-----	---	---	1.5-2.5	Apparent	Nov-May	>60	---	Moderate	Moderate	Low.
Fm-----Fillmore	D	None-----	---	---	+.5-1.0	Perched	Mar-Jul	>60	---	High-----	High-----	Low.
Gk-----Gibbon	B	Occasional	Very brief	Mar-Jul	1.5-3.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
Gs*:												
Gibbon-----	B	Occasional	Very brief	Mar-Jul	1.5-3.0	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Gs*:												
Gayville----------	D	Occasional	Brief-----	Mar-Oct	2.0-3.0	Apparent	Oct-Jun	>60	---	Moderate	High-----	Moderate.
HaC---------------- Hadar	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low------	Moderate.
Hd----------------- Hobbs	B	Occasional	Brief-----	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low------	Low.
He----------------- Hobbs	B	Frequent----	Brief-----	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low------	Low.
InB---------------- Inavale	A	Occasional	Very brief	Jan-Jul	>6.0	---	---	>60	---	Low------	Moderate	Low.
Ip*:												
Inavale-----------	A	Occasional	Very brief	Jan-Jul	>6.0	---	---	>60	---	Low------	Moderate	Low.
Boel--------------	A	Frequent----	Brief-----	Mar-Jun	1.5-3.5	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
La----------------- Lamo	C	Occasional	Brief-----	Mar-Aug	1.5-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
Lc----------------- Lamo	C	Occasional	Brief-----	Mar-May	0.5-1.5	Apparent	Nov-Jun	>60	---	High-----	High-----	Low.
Le----------------- Lamo	C	Occasional	Brief-----	Mar-Aug	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
Lf----------------- Lawet	B/D	Rare--------	---	---	1.0-2.0	Apparent	May-Nov	>60	---	High-----	High-----	Moderate.
LgC---------------- Libory	A	None--------	---	---	1.5-3.0	Perched	Mar-Jun	>60	---	Low------	Moderate	Low.
Lo, LoC, Lp, LpC-- Loretto	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Low.
Lt----------------- Loup	D	None--------	---	---	+.5-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
Ma----------------- Marlake	D	None--------	---	---	+2-1.0	Apparent	Oct-Jun	>60	---	Moderate	High-----	Low.
Mo, MoC, Mp-------- Moody	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Low.
Mu----------------- Muir	B	Rare--------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
NoC, NoD, NoE----- Nora	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
NpC2*, NpD2*:												
Nora	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Low.
Crofton	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Low.
Og, Oh: Ord	B	Occasional	Brief	Mar-May	1.5-3.5	Apparent	Nov-May	>60	---	High	High	Low.
OtC: Ortello	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ov: Ovina	B	Rare	---	---	1.0-3.0	Apparent	May-Nov	>60	---	High	Moderate	Low.
Pb*: Pits.												
Dumps.												
Sm, Sn: Shell	B	Occasional	Brief	Mar-Jun	>6.0	---	---	>60	---	Moderate	Low	Low.
Sv: Shell Variant	B	Occasional	Brief	Mar-Jun	2.5-4.0	Perched	Nov-Jun	>60	---	Moderate	Low	Low.
ThB, ThC, ThD, Tm: Thurman	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
VaD, VaF: Valentine	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
Zo: Zook	C/D	Occasional	Brief to long.	Feb-Nov	1.0-3.0	Apparent	Nov-May	>60	---	High	High	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available. NP means nonplastic]

Soil name, report number, horizon, and depth in inches [1]Location	Classification		Grain-size distribution								Liquid limit	Plasticity index	Specific gravity
			Percentage passing sieve--					Percentage smaller than--					
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm			
											Pct		G/cm3
Belfore silty clay loam (S77NE-119-14)													
Ap---- 0 to 7	A-6(10)	CL	100	100	100	---	99	94	35	29	38	15	2.64
Bt1--- 13 to 19	A-7-6(18)	CH	100	100	100	---	99	95	44	37	53	28	2.69
C----- 48 to 60	A-7-6(12)	CL	100	100	100	---	99	93	37	29	43	19	2.72
Elsmere loamy fine sand (S76NE-119-4)													
Ap---- 0 to 8	A-2-4(-2)	SM	100	100	100	92	13	12	4	3	NP	NP	2.64
C1---- 23 to 40	A-3(-2)	SP-SM	100	100	100	87	10	8	3	2	NP	NP	2.61
C2---- 40 to 60	A-3(-2)	SP-SM	100	100	100	87	10	7	4	3	NP	NP	2.62
Gibbon silty clay loam (S78NE-119-29)													
A1---- 0 to 10	A-7-6(16)	CH	100	100	100	99	74	68	27	19	51	26	2.58
Ck---- 27 to 42	A-6(12)	CL	100	100	96	93	73	63	15	12	38	22	2.70
C----- 42 to 60	A-2-4(0)	SM	100	98	97	94	28	16	5	4	18	2	2.64
Ord loam (S78NE-119-30)													
Ap---- 0 to 7	A-6(6)	CL	100	100	100	99	58	51	22	17	33	14	2.59
AC---- 16 to 24	A-2-4(0)	SM	100	100	100	98	32	22	9	8	28	NP	2.65
C2---- 32 to 48	A-2-4(0)	SM	100	100	100	98	17	10	5	4	NP	NP	2.61
Thurman loamy fine sand (S77NE-119-8)													
A---- 0 to 12	A-2-4(0)	SM	100	100	100	96	17	12	5	3	NP	NP	2.59
AC--- 12 to 17	A-2-4(-2)	SM	100	100	100	97	13	10	5	4	NP	NP	2.63
C2--- 29 to 60	A-3(-2)	SM	100	100	100	97	10	8	4	4	NP	NP	2.62

[1]Location for each sample site is the same as that given in the soil series descriptions.

TABLE 19.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Alcester	Fine-silty, mixed, mesic Cumulic Haplustolls
Bazile	Fine-silty over sandy or sandy-skeletal, mixed, mesic Udic Argiustolls
Belfore	Fine, montmorillonitic, mesic Udic Haplustolls
Blendon	Coarse-loamy, mixed, mesic Pachic Haplustolls
Boel	Sandy, mixed, mesic Fluvaquentic Haplustolls
Boelus	Sandy over loamy, mixed, mesic Udic Haplustolls
Cass	Coarse-loamy, mixed, mesic Fluventic Haplustolls
Clarno	Fine-loamy, mixed, mesic Typic Haplustolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Crofton	Fine-silty, mixed (calcareous), mesic Typic Ustorthents
Elsmere	Sandy, mixed, mesic Aquic Haplustolls
Fillmore	Fine, montmorillonitic, mesic Typic Argialbolls
*Gayville	Fine, montmorillonitic, mesic Leptic Natrustolls
Gibbon	Fine-silty, mixed (calcareous), mesic Fluvaquentic Haplaquolls
Hadar	Sandy over loamy, mixed, mesic Udic Haplustolls
Hobbs	Fine-silty, mixed, nonacid, mesic Mollic Ustifluvents
Inavale	Sandy, mixed, mesic Typic Ustifluvents
Lamo	Fine-silty, mixed (calcareous), mesic Cumulic Haplaquolls
*Lawet	Fine-loamy, mesic Typic Calciaquolls
Libory	Sandy over loamy, mixed, mesic Aquic Haplustolls
Loretto	Fine-loamy, mixed, mesic Udic Argiustolls
Loup	Sandy, mixed, mesic Typic Haplaquolls
Marlake	Sandy, mixed, mesic Mollic Fluvaquents
Moody	Fine-silty, mixed, mesic Udic Haplustolls
Muir	Fine-silty, mixed, mesic Cumulic Haplustolls
Nora	Fine-silty, mixed, mesic Udic Haplustolls
Ord	Coarse-loamy over sandy or sandy skeletal, mesic Aeric Calciaquolls
Ortello	Coarse-loamy, mixed, mesic Udic Haplustolls
Ovina	Coarse-loamy, mixed, mesic Fluvaquentic Haplustolls
Shell	Fine-silty, mixed, mesic Cumulic Haplustolls
Shell Variant	Fine-silty, mixed, mesic Cumulic Haplustolls
Thurman	Sandy, mixed, mesic Udorthentic Haplustolls
Valentine	Mixed, mesic Typic Ustipsamments
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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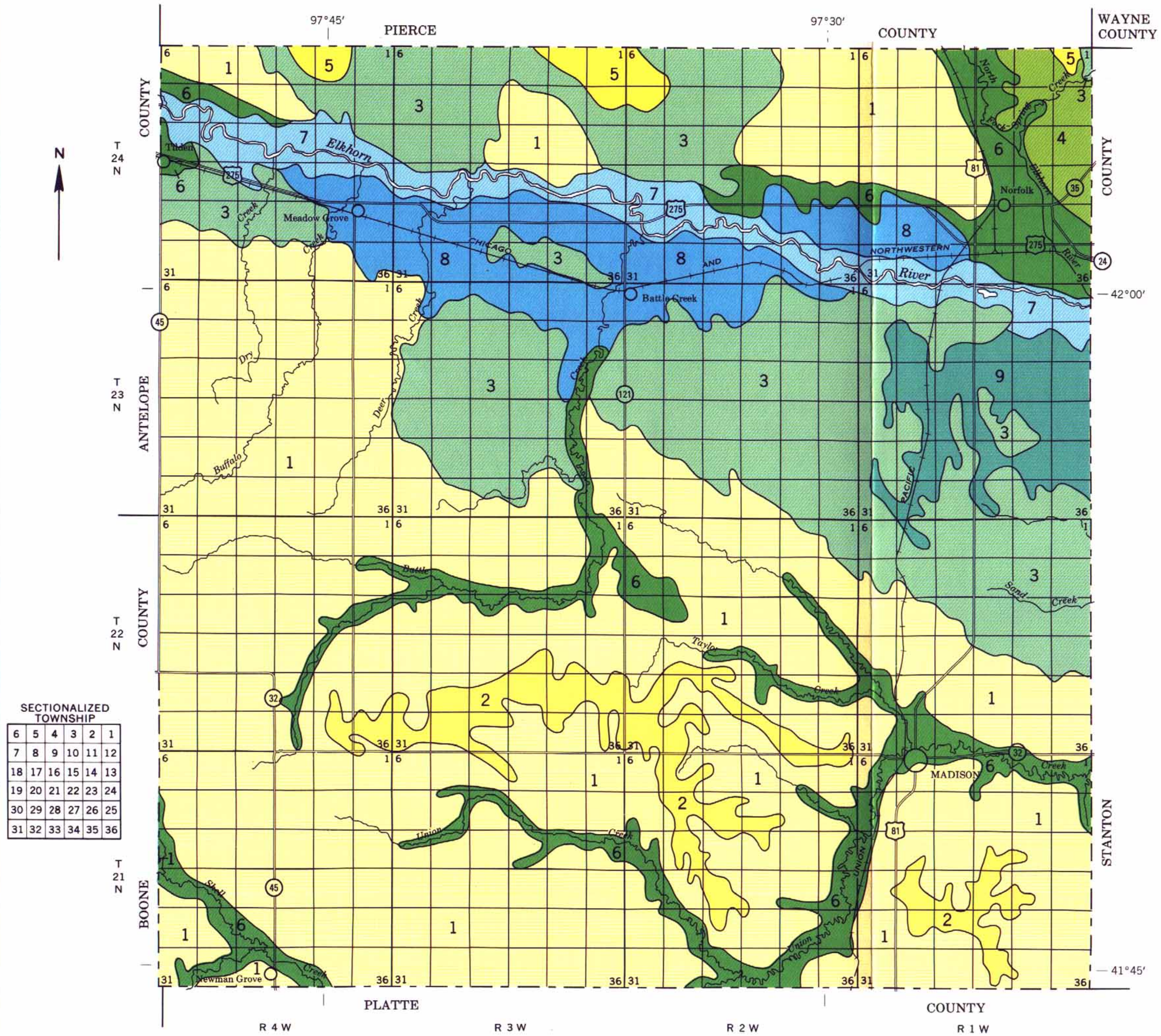


Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

LEGEND*

SILTY SOILS ON UPLANDS

1 — Nora-Crofton-Moody association: Deep, nearly level to steep, well drained and somewhat excessively drained silty soils that formed in loess; on uplands

2 — Belfore-Moody-Nora association: Deep, nearly level to strongly sloping, well drained silty soils that formed in loess; on uplands

SANDY AND LOAMY SOILS ON UPLANDS AND STREAM TERRACES

3 — Thurman-Loretto-Boelus association: Deep, nearly level to strongly sloping, somewhat excessively drained and well drained sandy and loamy soils that formed in eolian sands and loess; on uplands and stream terraces

4 — Thurman-Hadar-Blendon association: Deep, nearly level to strongly sloping, somewhat excessively drained and well drained sandy and loamy soils that formed in eolian sands, alluvium, and glacial till; on uplands and stream terraces

SANDY SOILS ON UPLANDS

5 — Thurman-Valentine association: Deep, very gently sloping to steep, somewhat excessively drained and excessively drained sandy soils that formed in eolian sands; on uplands

SILTY SOILS ON BOTTOM LANDS AND STREAM TERRACES

6 — Muir-Shell-Hobbs association: Deep, nearly level, well drained silty soils that formed in alluvium; on bottom lands and stream terraces

SANDY, LOAMY, AND SILTY SOILS ON BOTTOM LANDS

7 — Ord-Inavale-Boelus association: Deep, nearly level to gently sloping, somewhat poorly drained and somewhat excessively drained loamy and sandy soils that formed in alluvium; on bottom lands

8 — Gibbon-Lamo-Ord association: Deep, nearly level, somewhat poorly drained and poorly drained silty and loamy soils that formed in alluvium; on bottom lands

SANDY SOILS ON BOTTOM LANDS, STREAM TERRACES, AND UPLANDS

9 — Elsmere-Thurman association: Deep, nearly level and very gently sloping, somewhat poorly drained and somewhat excessively drained sandy soils that formed in eolian sands; on uplands, stream terraces, and bottom lands and in upland valleys

*Texture named in descriptive headings refers to the surface texture of the major soils.

Compiled 1983

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
UNIVERSITY OF NEBRASKA CONSERVATION AND SURVEY DIVISION

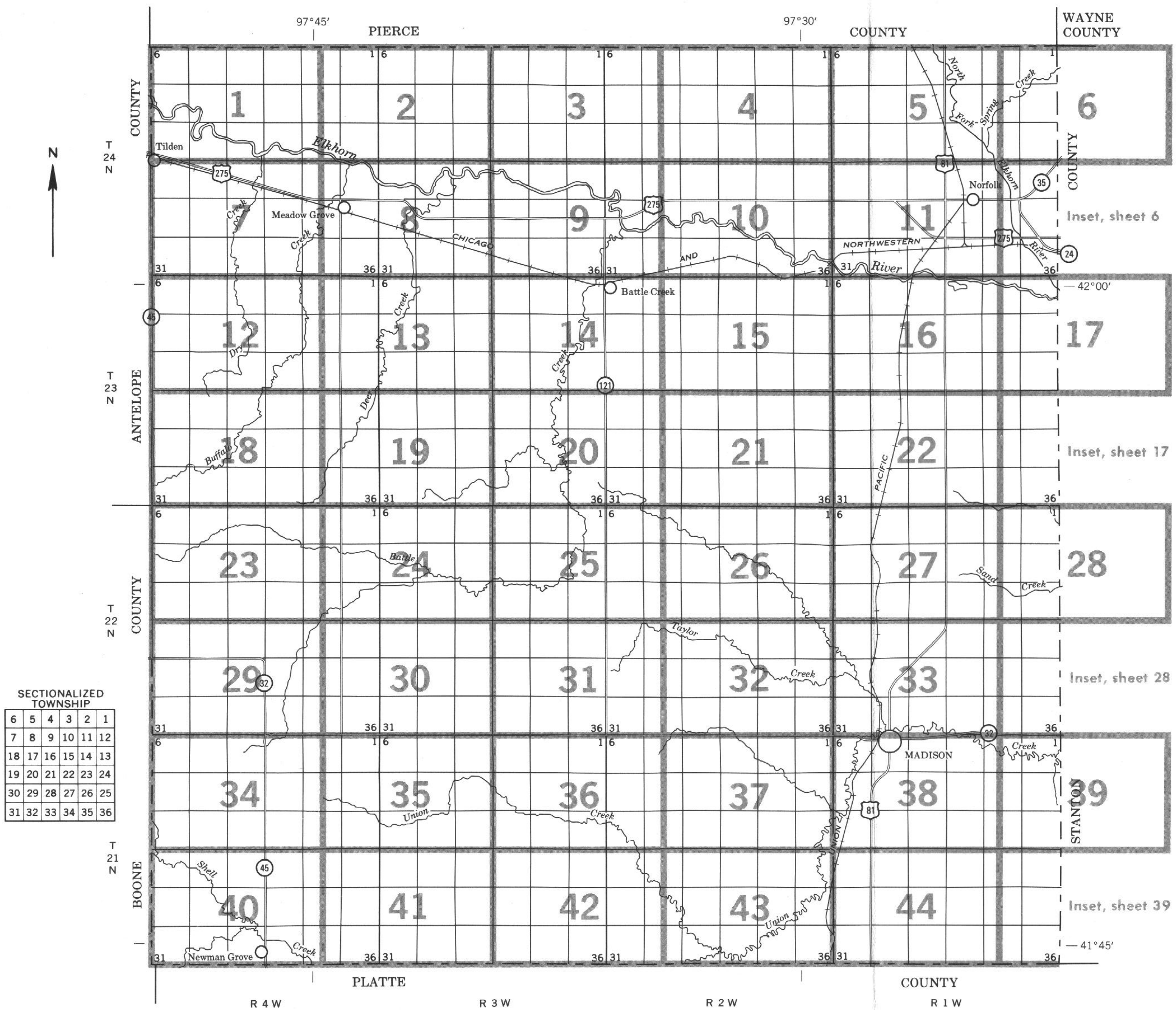
GENERAL SOIL MAP

MADISON COUNTY, NEBRASKA

Scale 1:190,080

1 0 1 2 3 Miles

1 0 3 6 Km



INDEX TO MAP SHEETS
MADISON COUNTY, NEBRASKA

Scale 1:190,080

1 0 1 2 3 Miles

1 0 3 6 Km

SOIL LEGEND

Map symbols consist of a combination of letters or of letters and a number. The first capital letter is the initial one of the map unit name. The lowercase letter that follows separates map units having names that begin with the same letter, except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 indicates that the soil is eroded.

SYMBOL	NAME
AcC	Alcester silty clay loam, 2 to 6 percent slopes
BdC	Bazile loam, 2 to 6 percent slopes
Be	Belfore silty clay loam, 0 to 2 percent slopes
Bn	Blendon fine sandy loam, 0 to 2 percent slopes
Bp	Boel fine sandy loam, 0 to 2 percent slopes
Br	Boel loamy fine sand, channeled
BsC	Boelus loamy fine sand, 2 to 6 percent slopes
Cf	Cass fine sandy loam, 0 to 2 percent slopes
Cg	Cass loam, 0 to 1 percent slopes
CnC	Clarno loam, 2 to 6 percent slopes
Co	Colo silty clay loam, 0 to 1 percent slopes
CrC2	Crofton silt loam, 2 to 6 percent slopes, eroded
CrD2	Crofton silt loam, 6 to 11 percent slopes, eroded
CrF	Crofton silt loam, 15 to 30 percent slopes
CrG	Crofton silt loam, 30 to 60 percent slopes
CuE2	Crofton-Nora complex, 11 to 15 percent slopes, eroded
Eh	Elsmere loamy fine sand, 0 to 2 percent slopes
Ek	Elsmere fine sandy loam, 0 to 1 percent slopes
Fm	Fillmore silt loam, 0 to 1 percent slopes
Gk	Gibbon silty clay loam, 0 to 1 percent slopes
Gs	Gibbon-Gayville silty clay loams, 0 to 1 percent slopes
HaC	Hadar loamy fine sand, 2 to 6 percent slopes
Hd	Hobbs silt loam, 0 to 2 percent slopes
He	Hobbs silt loam, channeled
InB	Inavale loamy fine sand, 0 to 3 percent slopes
Ip	Inavale-Boel complex, 0 to 6 percent slopes
La	Lamo silty clay loam, 0 to 1 percent slopes
Lc	Lamo silty clay loam, wet, 0 to 1 percent slopes
Le	Lamo silt loam, 0 to 1 percent slopes
Lf	Lawet loam, 0 to 1 percent slopes
LgC	Libory loamy fine sand, 2 to 6 percent slopes
Lo	Loretto fine sandy loam, 0 to 2 percent slopes
LoC	Loretto fine sandy loam, 2 to 6 percent slopes
Lp	Loretto loam, 0 to 2 percent slopes
LpC	Loretto loam, 2 to 6 percent slopes
Lt	Loup loamy fine sand, wet, 0 to 1 percent slopes
Ma	Marlake loam, 0 to 1 percent slopes
Mo	Moody silty clay loam, 0 to 2 percent slopes
MoC	Moody silty clay loam, 2 to 6 percent slopes
Mp	Moody silty clay loam, terrace, 0 to 1 percent slopes
Mu	Muir silty clay loam, 0 to 1 percent slopes
NoC	Nora silty clay loam, 2 to 6 percent slopes
NoD	Nora silty clay loam, 6 to 11 percent slopes
NoE	Nora silty clay loam, 11 to 15 percent slopes
NpC2	Nora-Crofton complex, 2 to 6 percent slopes, eroded
NpD2	Nora-Crofton complex, 6 to 11 percent slopes, eroded
Og	Ord fine sandy loam, 0 to 2 percent slopes
Oh	Ord loam, 0 to 1 percent slopes
OtC	Ortello fine sandy loam, 2 to 6 percent slopes
Ov	Ovina fine sandy loam, 0 to 2 percent slopes
Pb	Pits and dumps
Sm	Shell silt loam, 0 to 1 percent slopes
Sn	Shell silty clay loam, 0 to 1 percent slopes
Sv	Shell Variant silty clay loam, 0 to 1 percent slopes
ThB	Thurman loamy fine sand, 1 to 3 percent slopes
ThC	Thurman loamy fine sand, 3 to 6 percent slopes
ThD	Thurman loamy fine sand, 6 to 11 percent slopes
Tm	Thurman loamy fine sand, thick, 0 to 2 percent slopes
VaD	Valentine fine sand, 3 to 9 percent slopes
VaF	Valentine fine sand, 9 to 20 percent slopes
Zo	Zook silty clay loam, 0 to 1 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- County
- Reservation (national forest or park, state forest or park, and large airport)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Federal
- State
- County, farm or ranch

RAILROAD

LEVEES

- Without road

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end

LAKES, PONDS AND RESERVOIRS

- Perennial

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

SHORT STEEP SLOPE

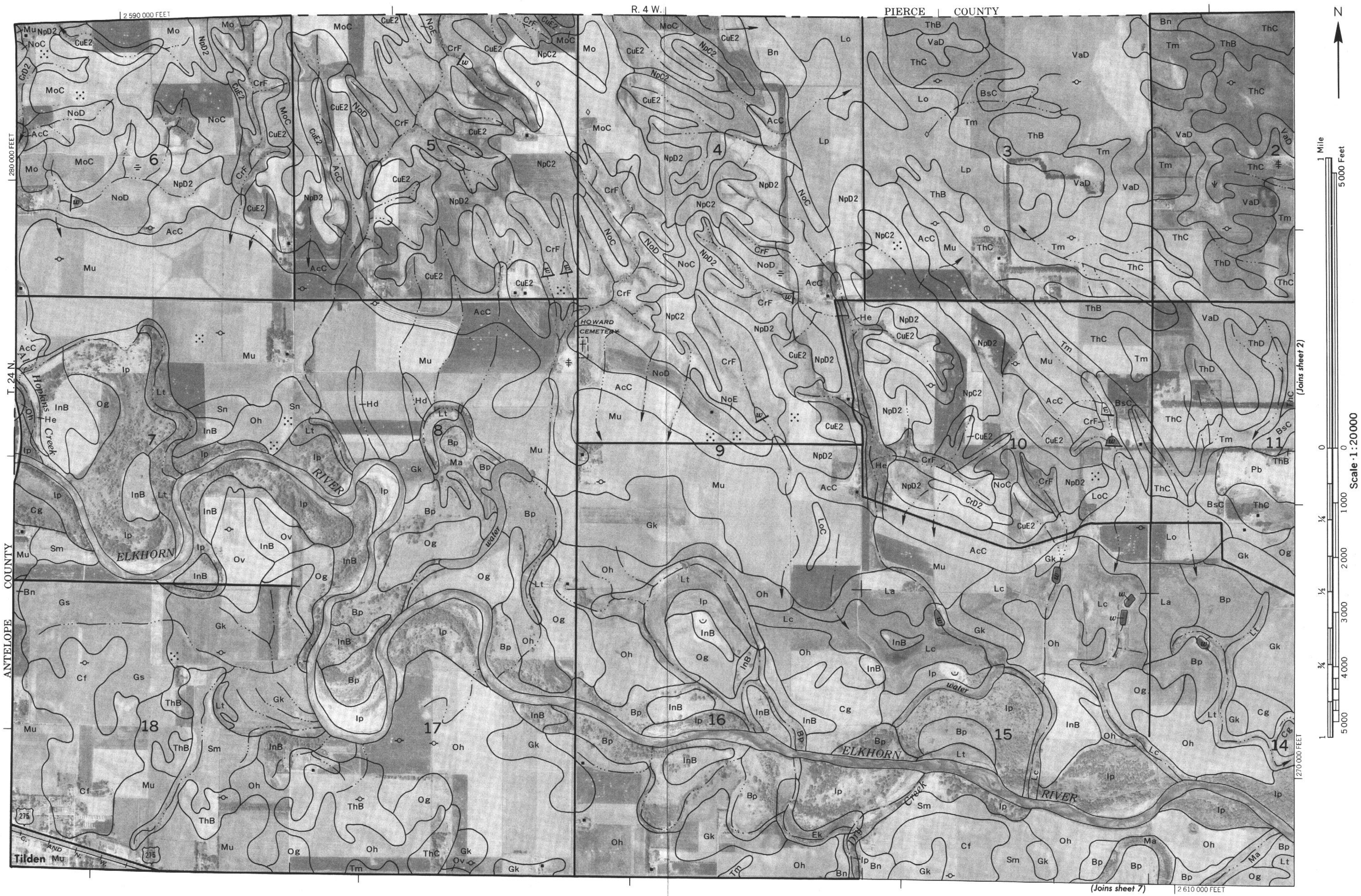
GULLY

DEPRESSION OR SINK

MISCELLANEOUS

- Blowout
- Gumbo, slick or scabby spot (sodic)
- Saline spot
- Sandy spot
- Severely eroded spot
- Silty outcrop spot
- Sanitary landfill
- Glacial till spot
- Reddish brown silty spot

MADISON COUNTY, NEBRASKA — SHEET NUMBER 1



MADISON COUNTY, NEBRASKA NO. 1

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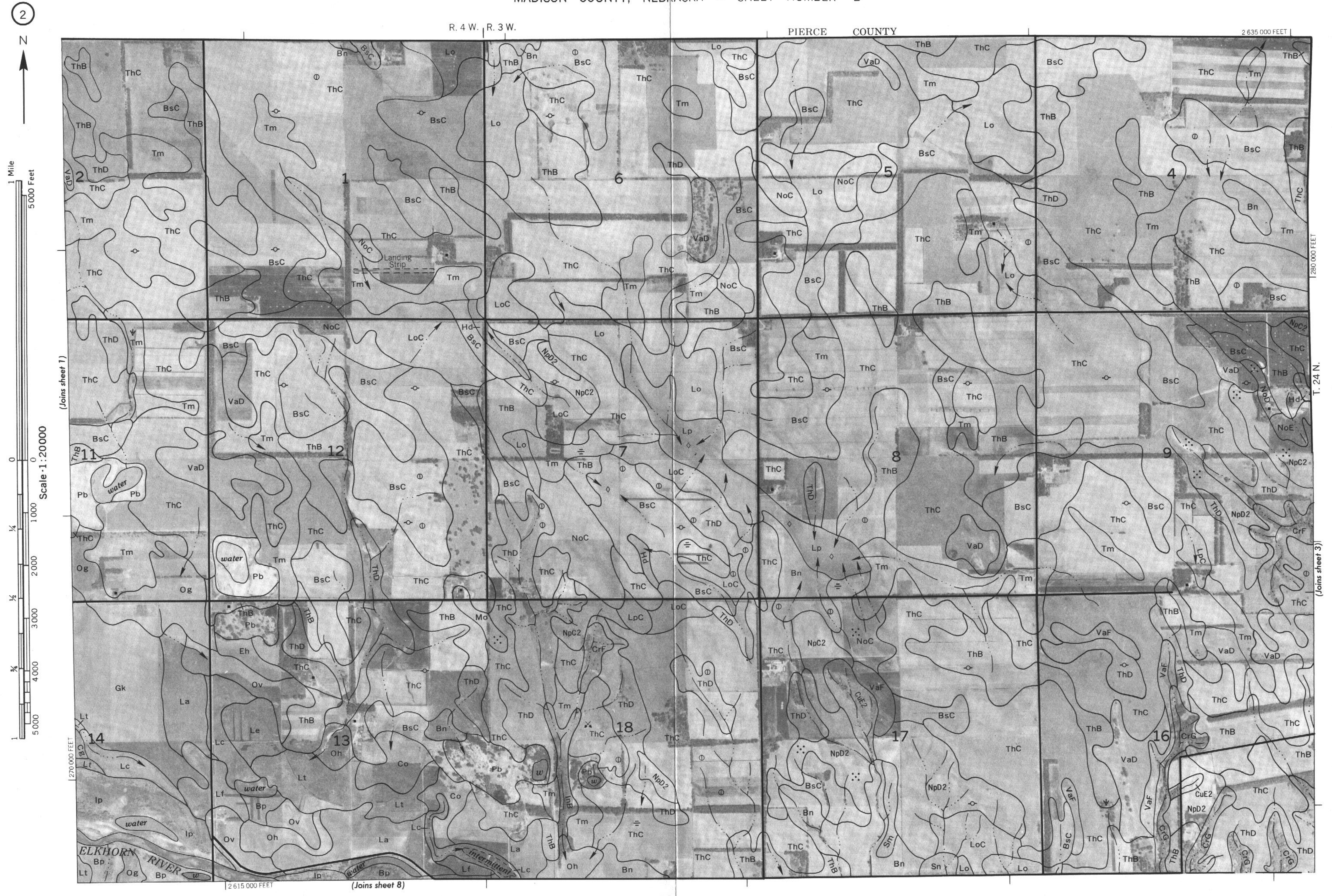
MADISON COUNTY, NEBRASKA — SHEET NUMBER 2



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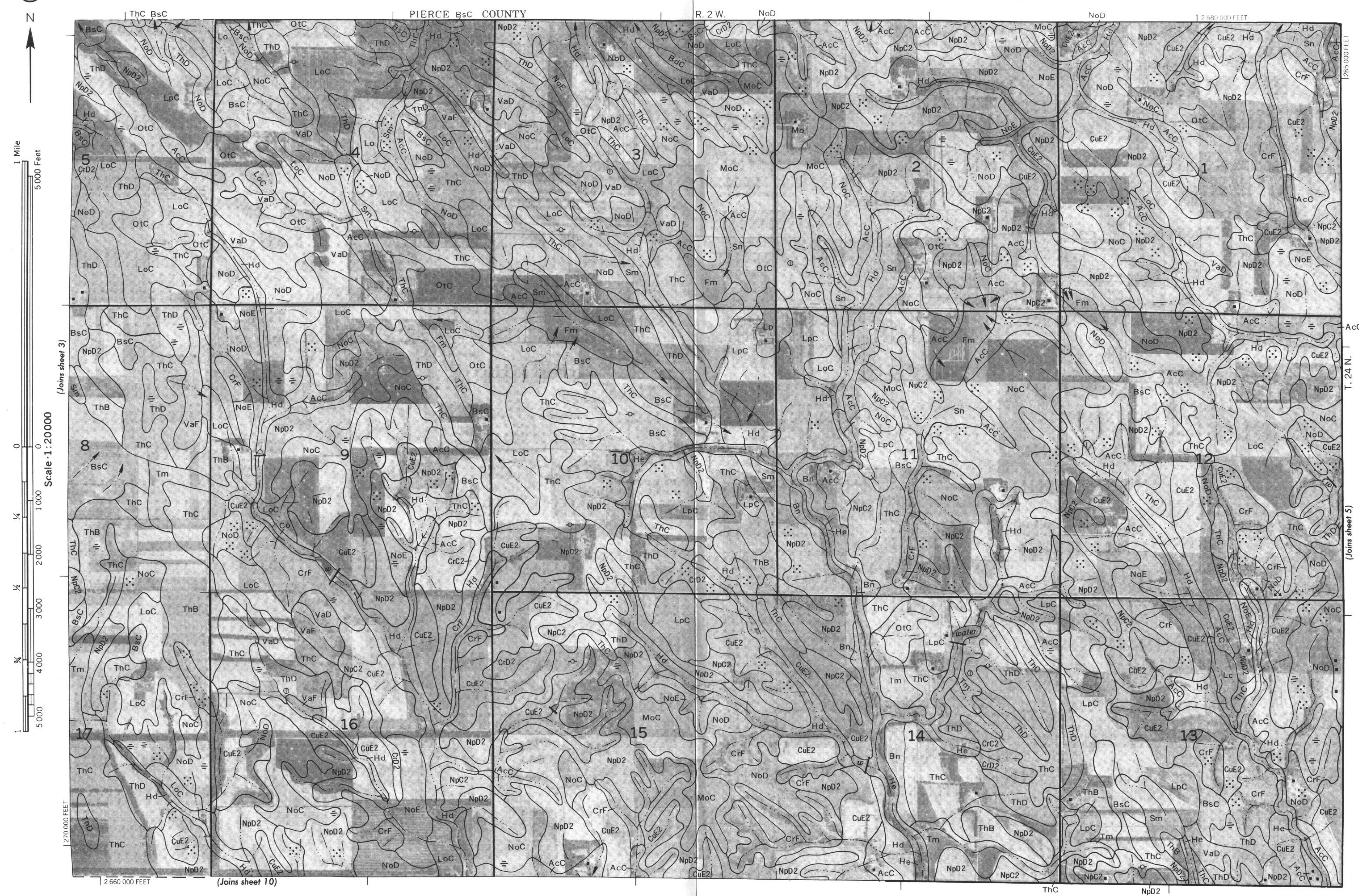

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MADISON COUNTY, NEBRASKA NO. 5

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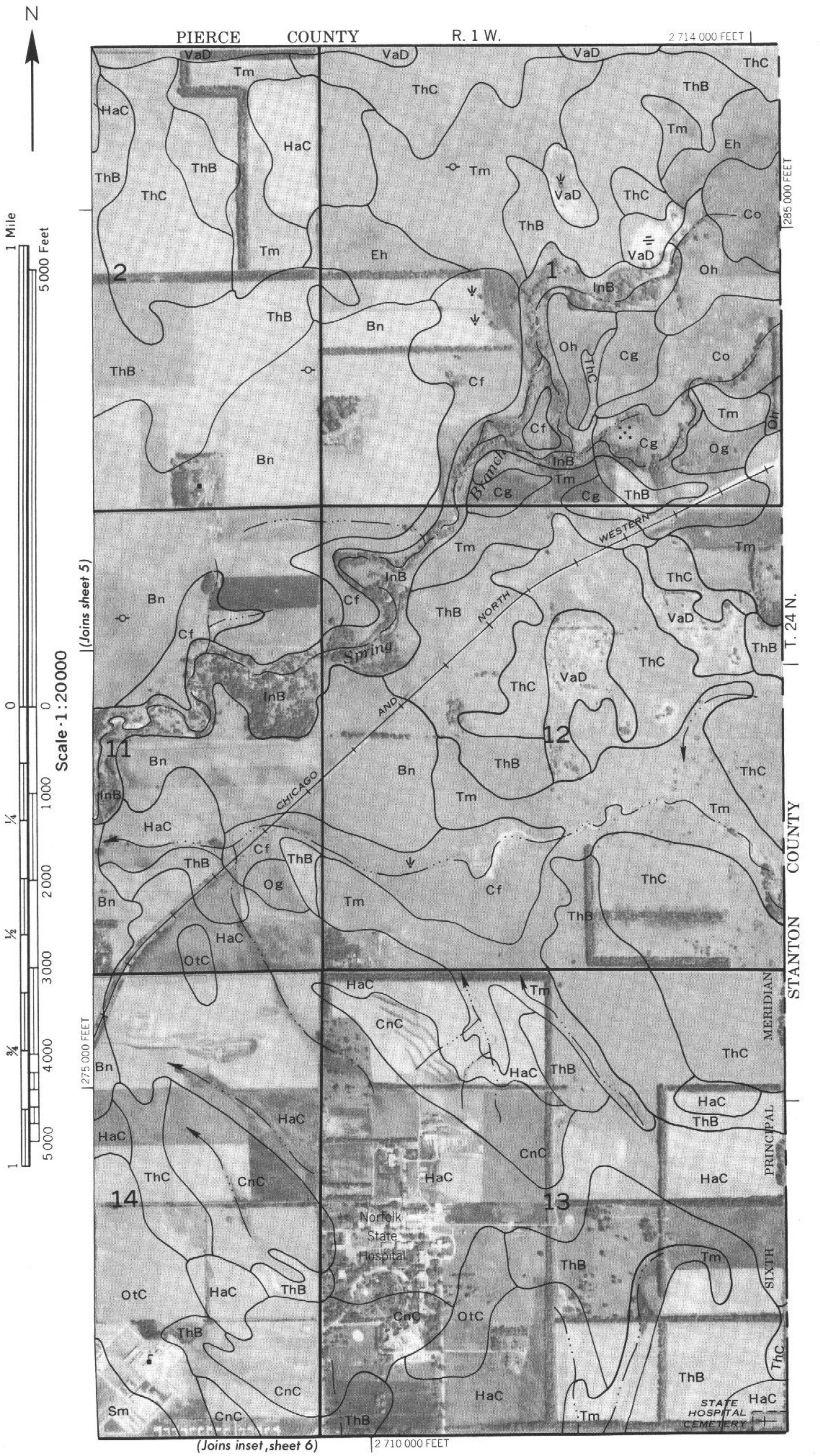

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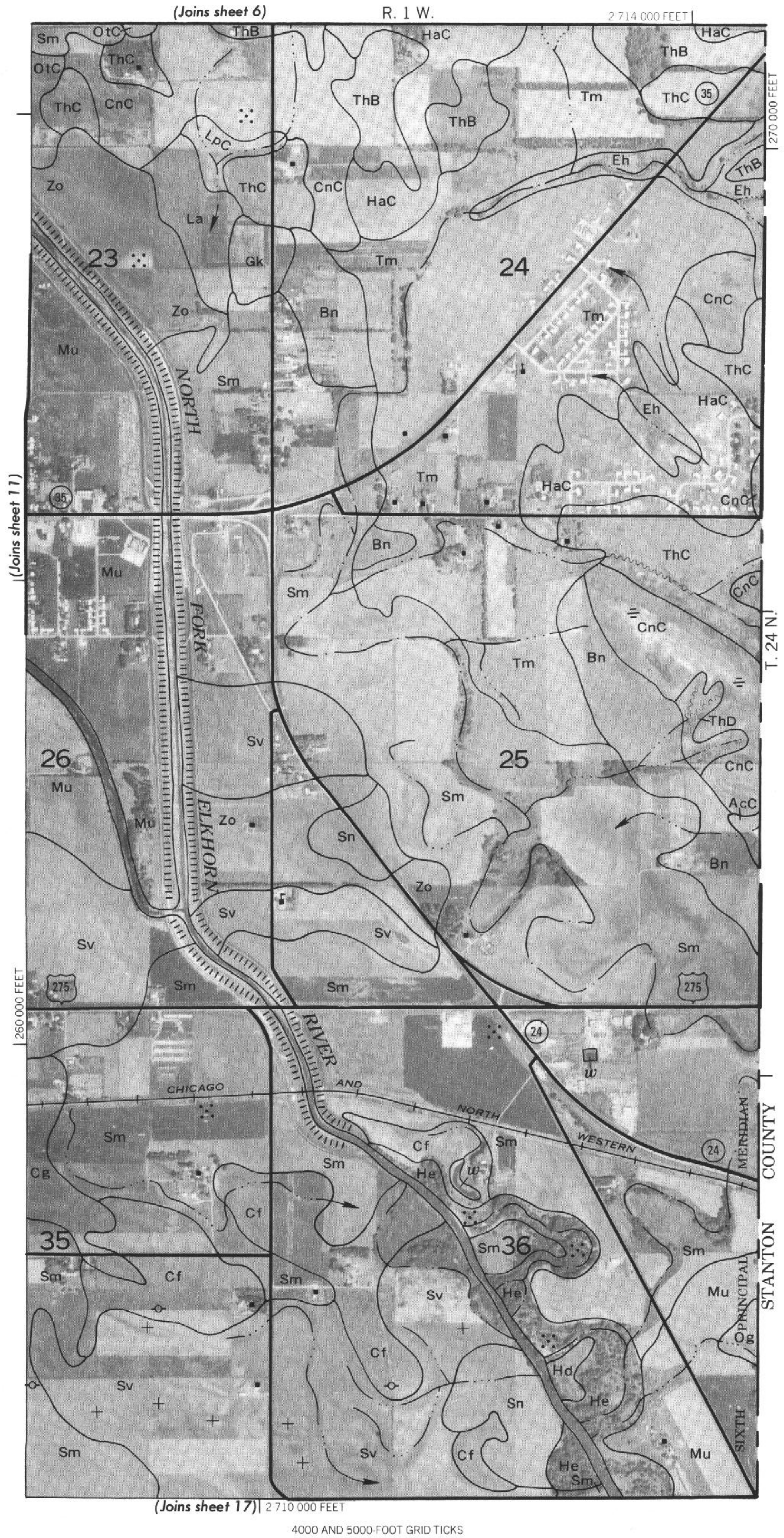

4000 AND 5000-FOOT GRID TICKS

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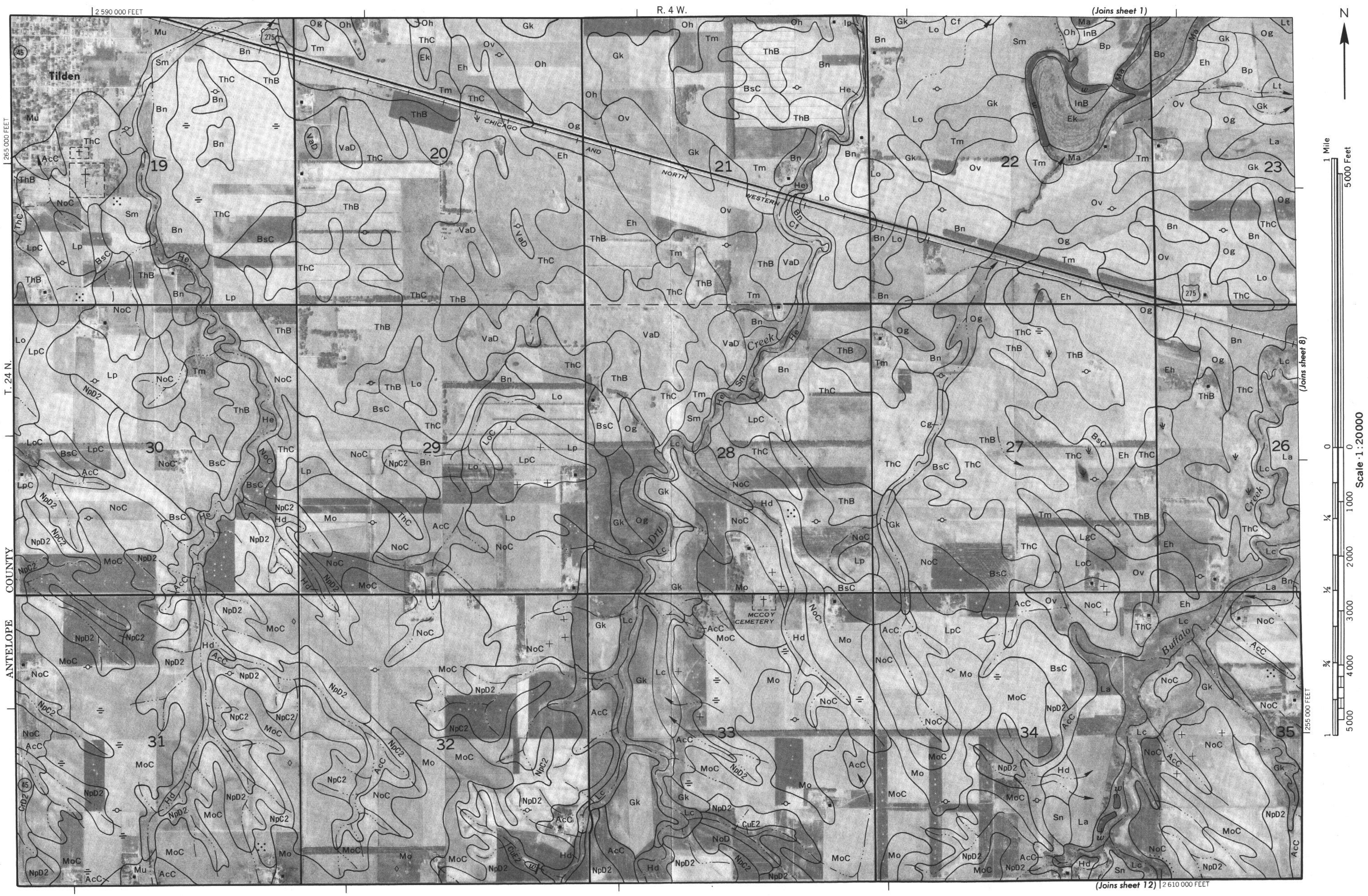

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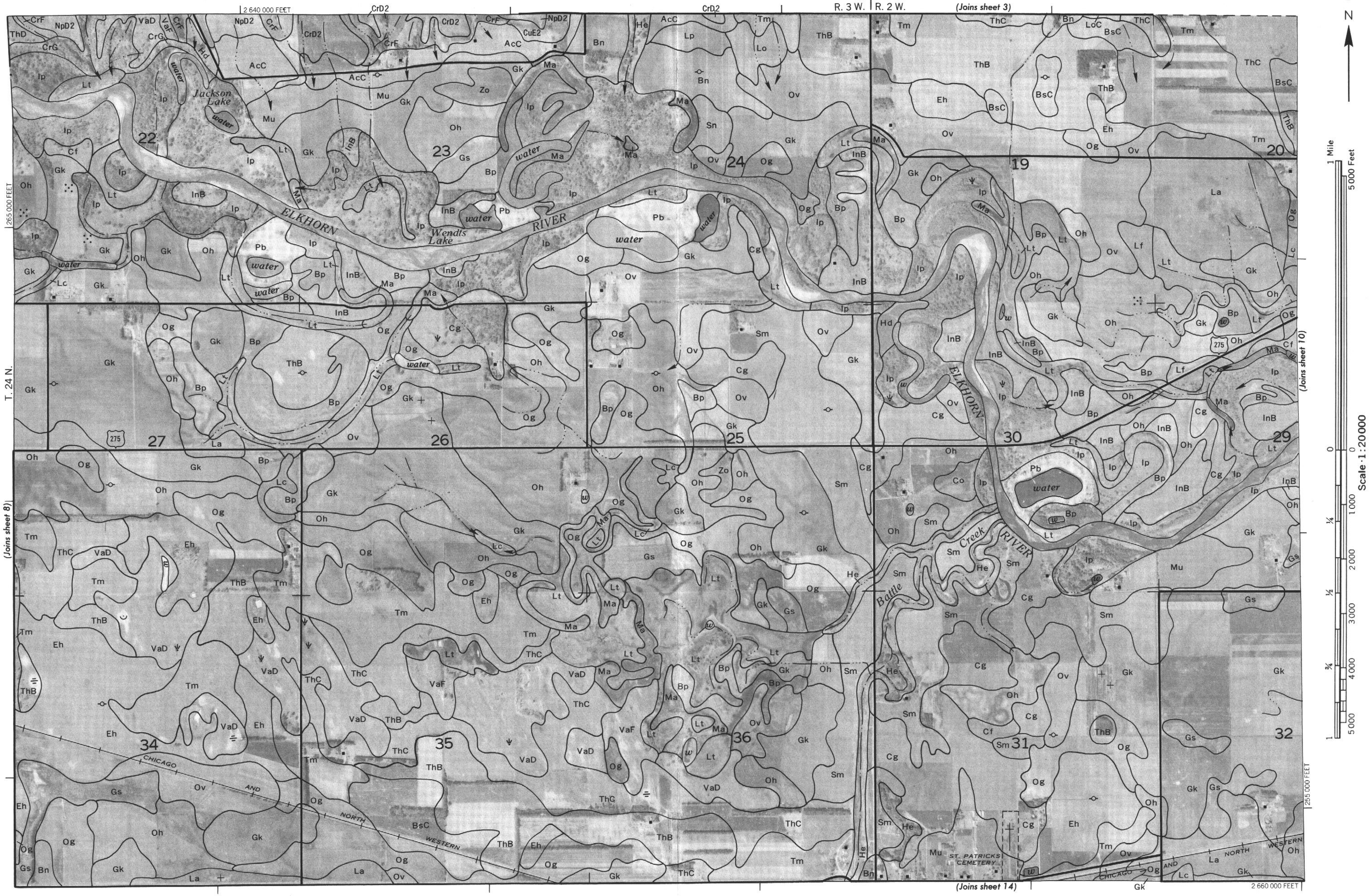
9



MADISON COUNTY, NEBRASKA NO. 9

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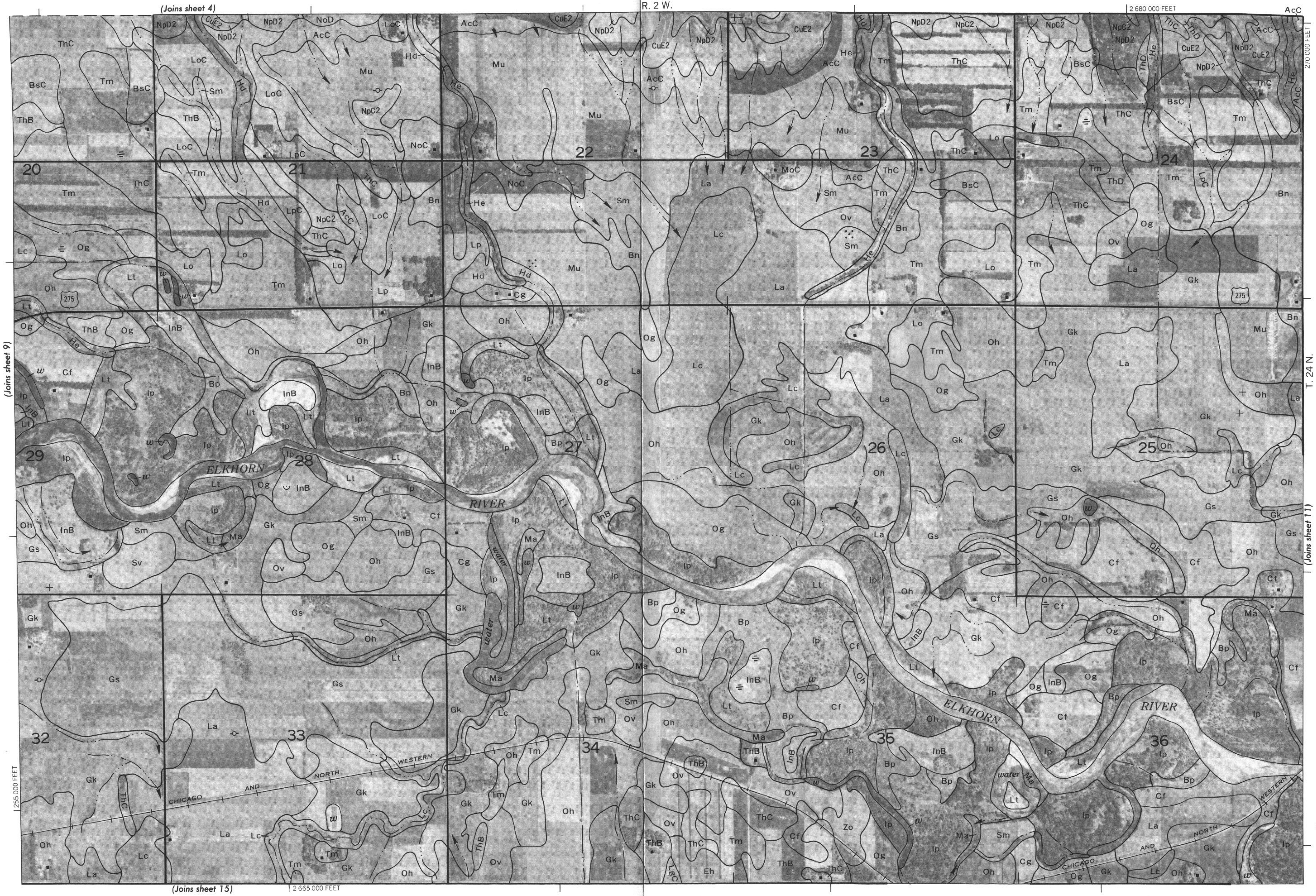
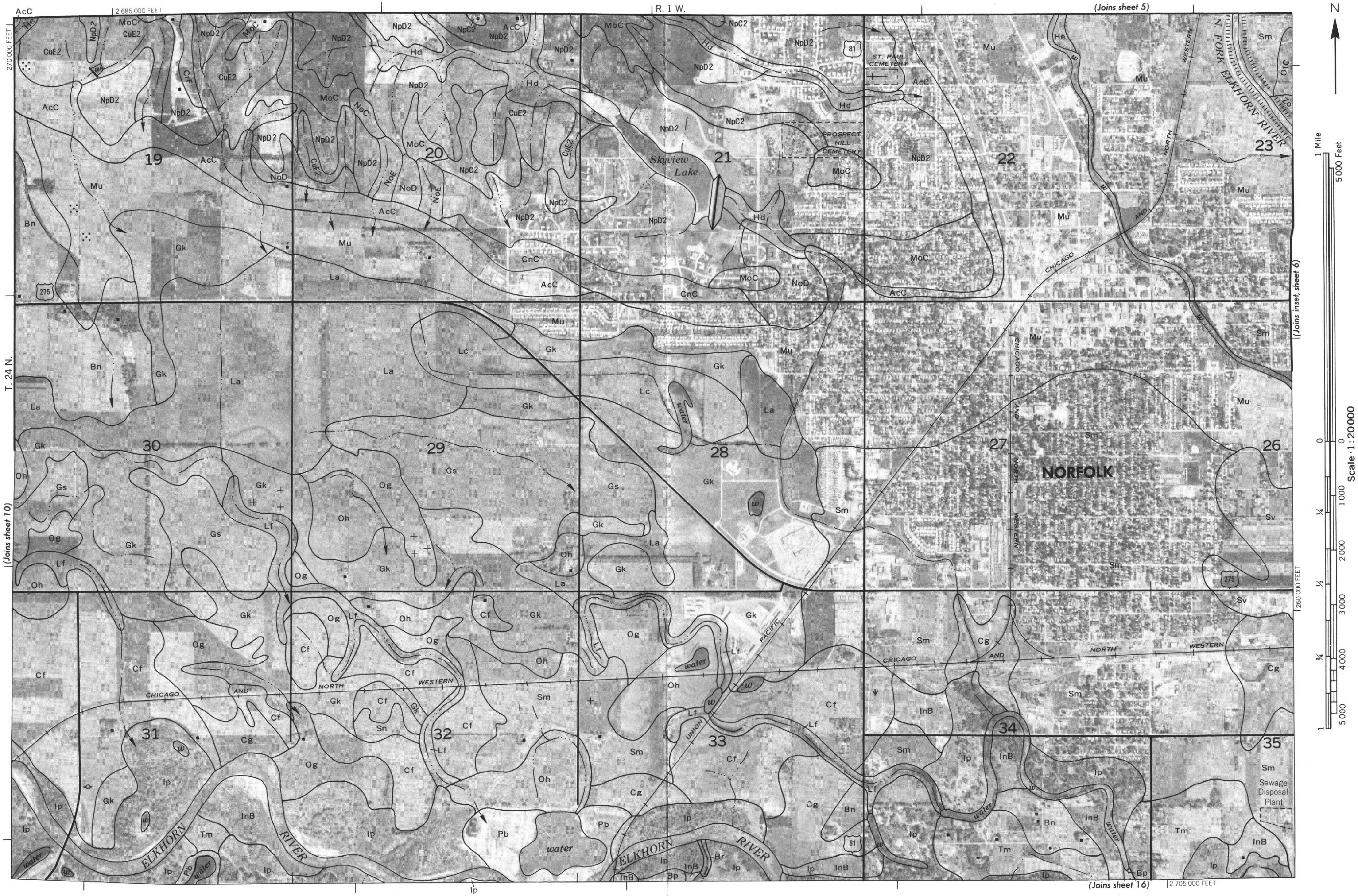
(10)

N



1 Mile
5000 Feet
Scale 1:20000
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

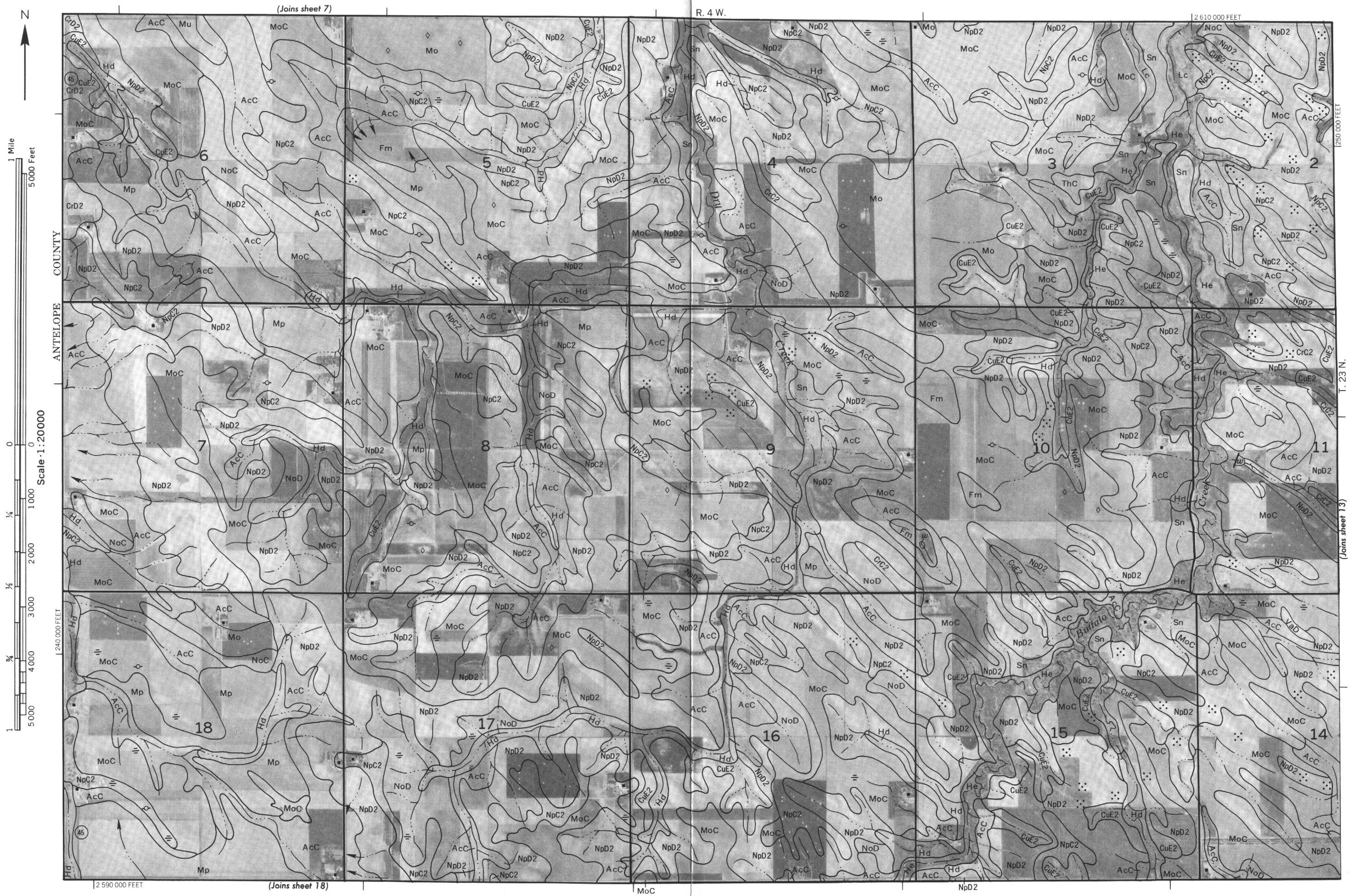
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



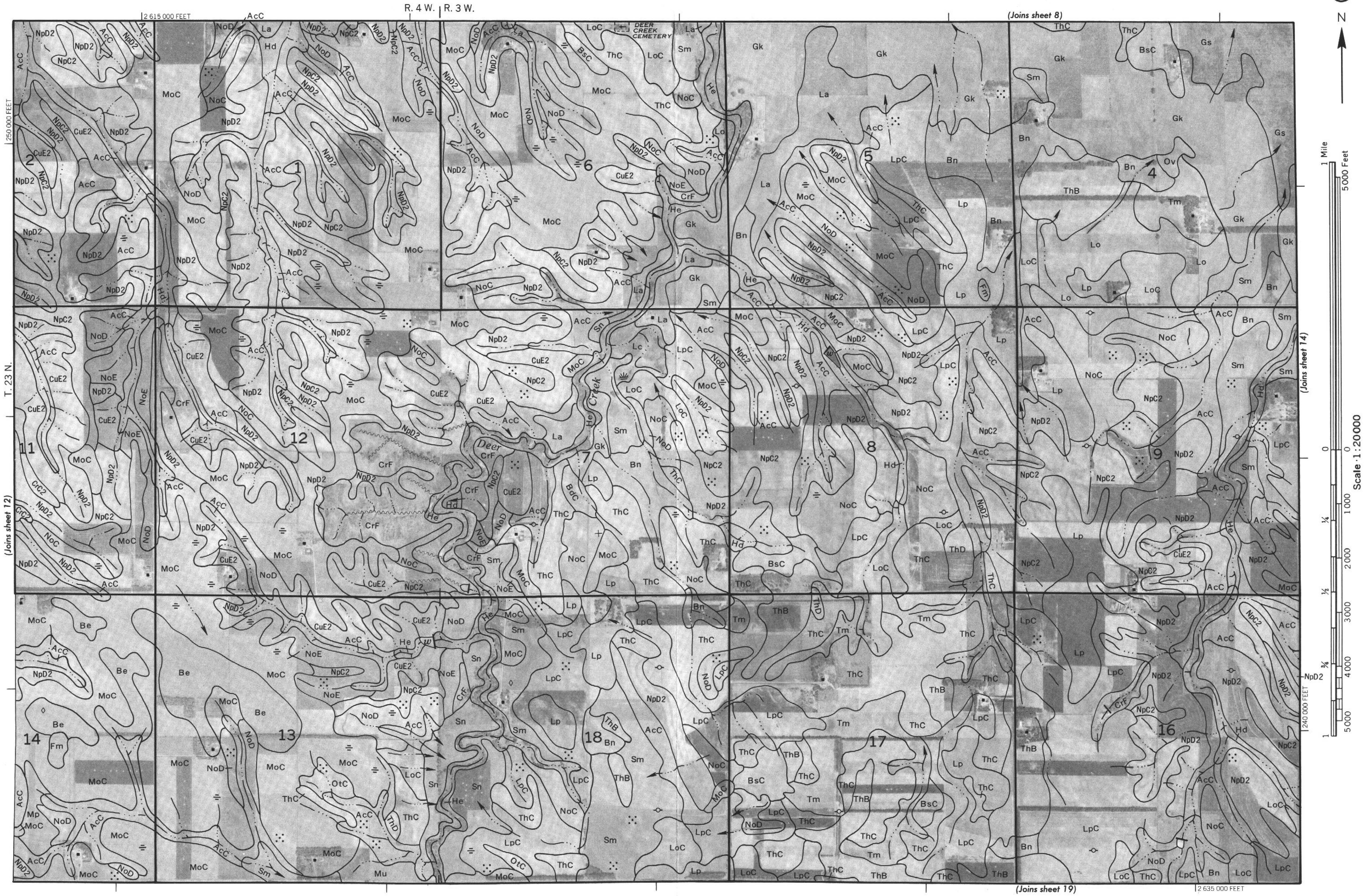
MADISON COUNTY, NEBRASKA NO. 11

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA — SHEET NUMBER 12

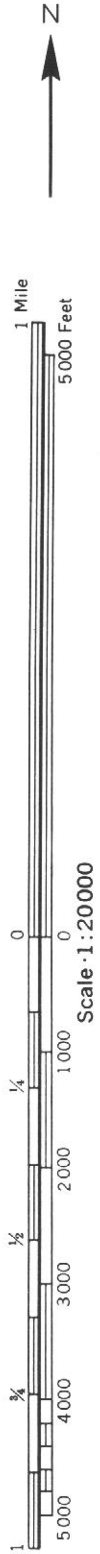


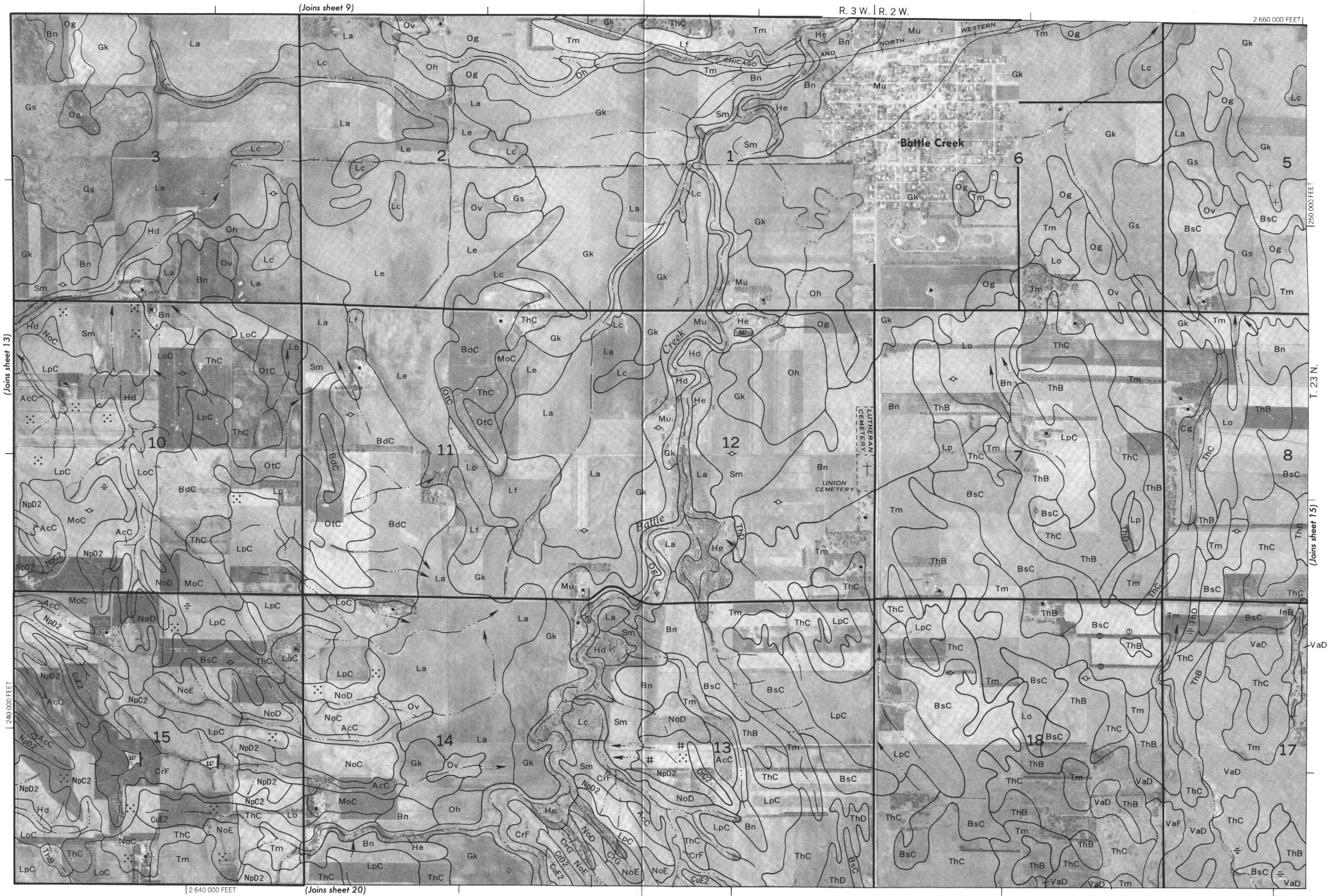
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



MADISON COUNTY, NEBRASKA NO. 13

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





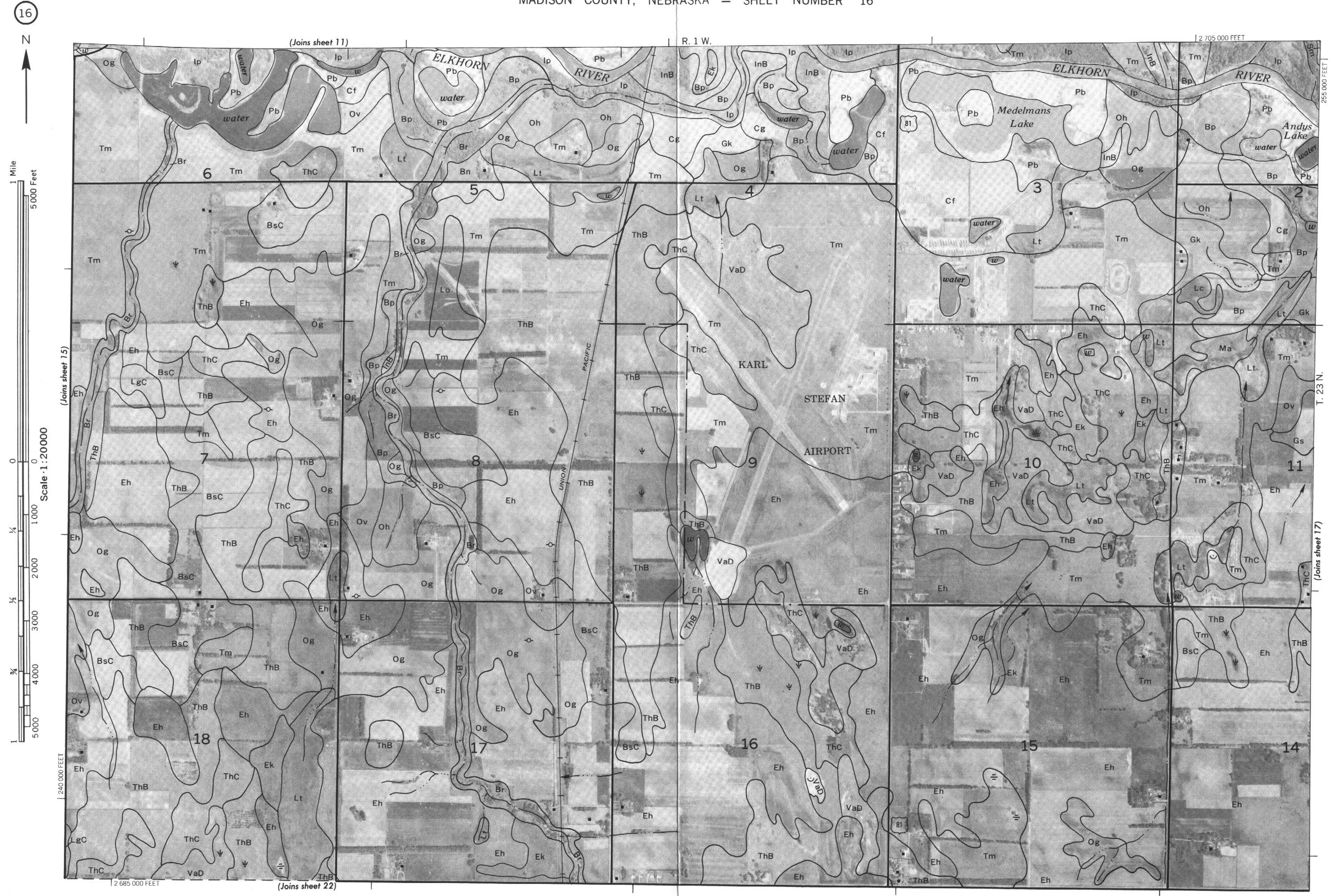
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA NO. 14

15

MADISON COUNTY, NEBRASKA NO. 15

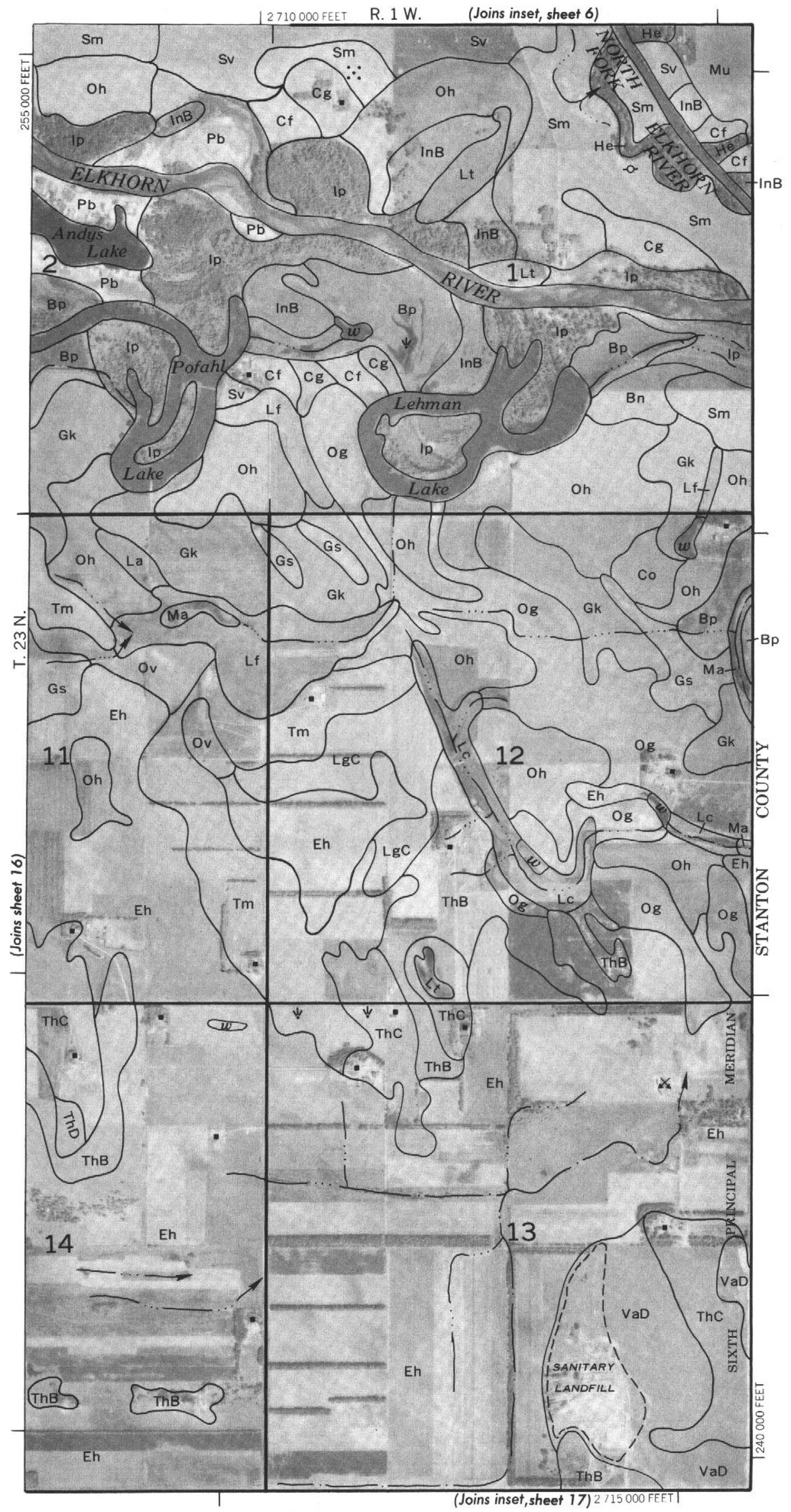
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

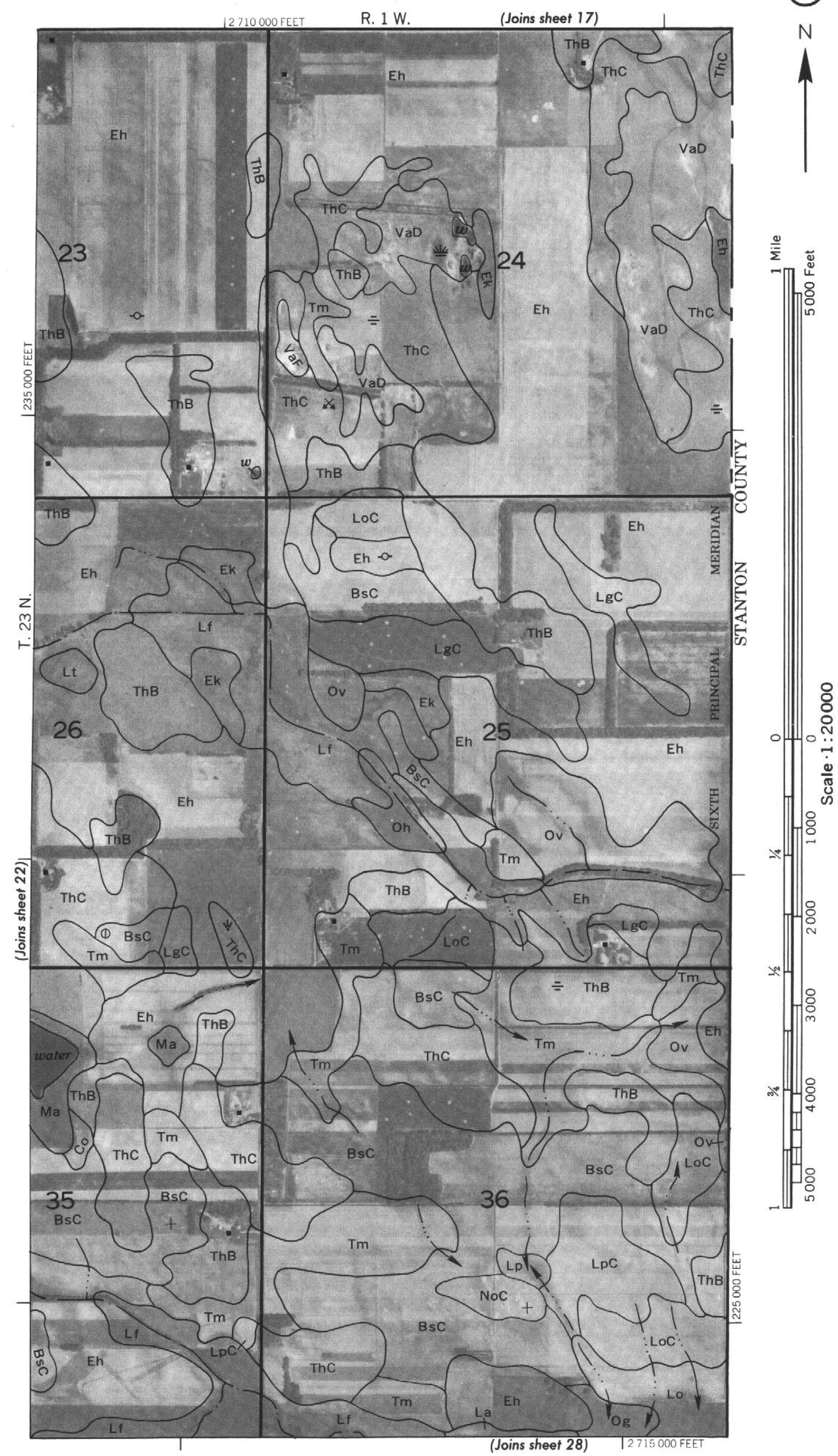


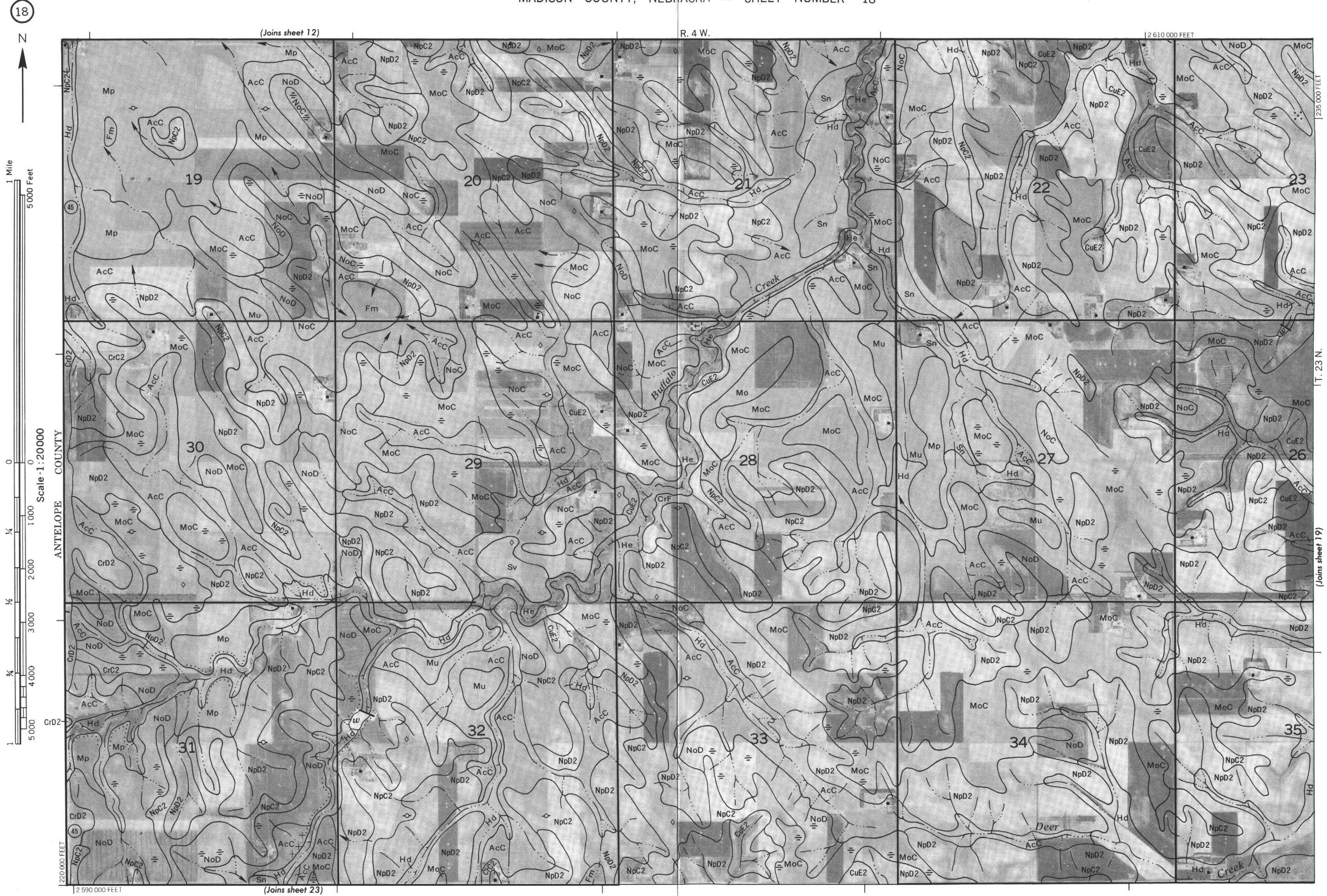
MADISON COUNTY, NEBRASKA NO. 16

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA NO. 17
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

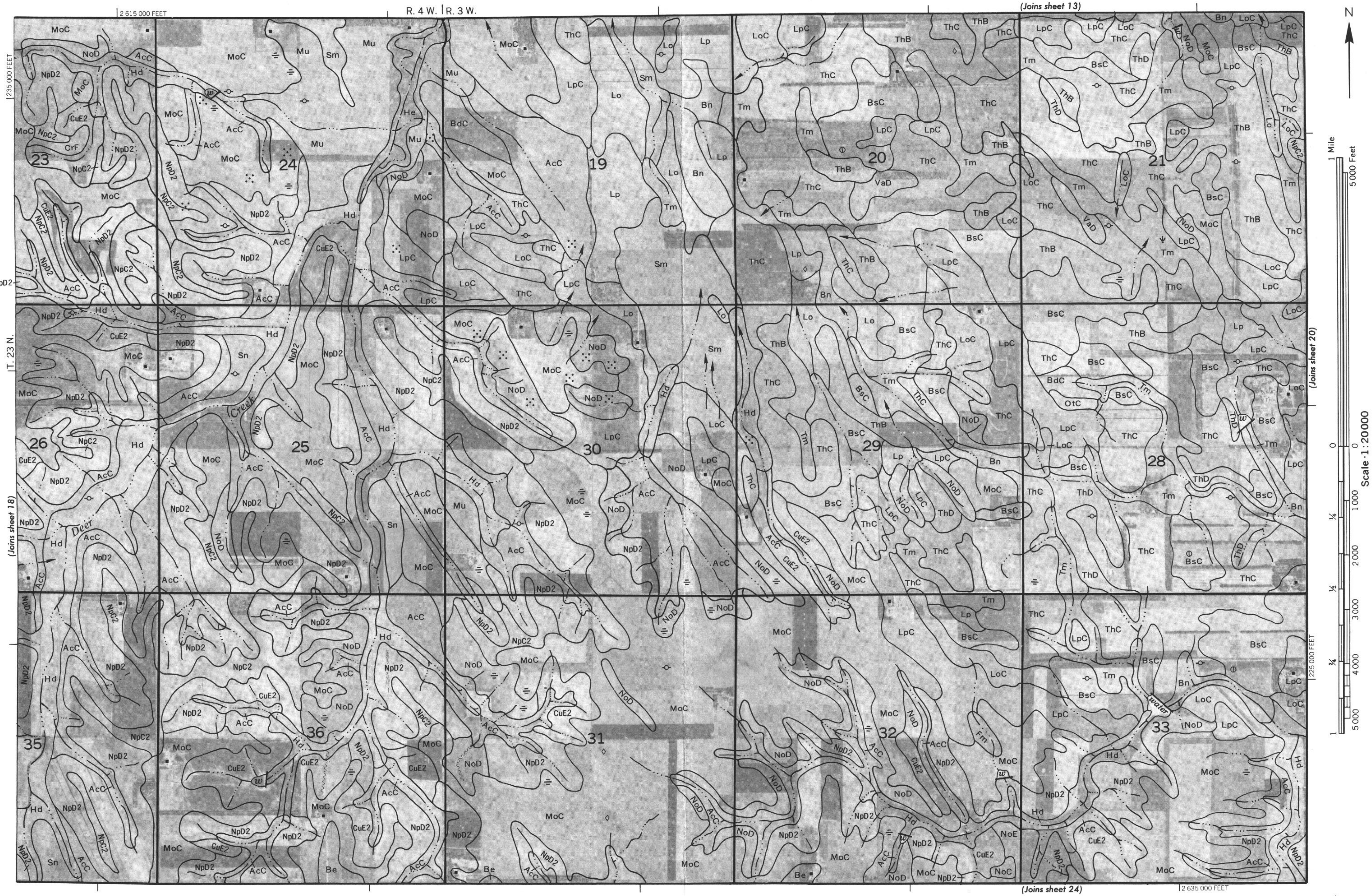






This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA NO. 18

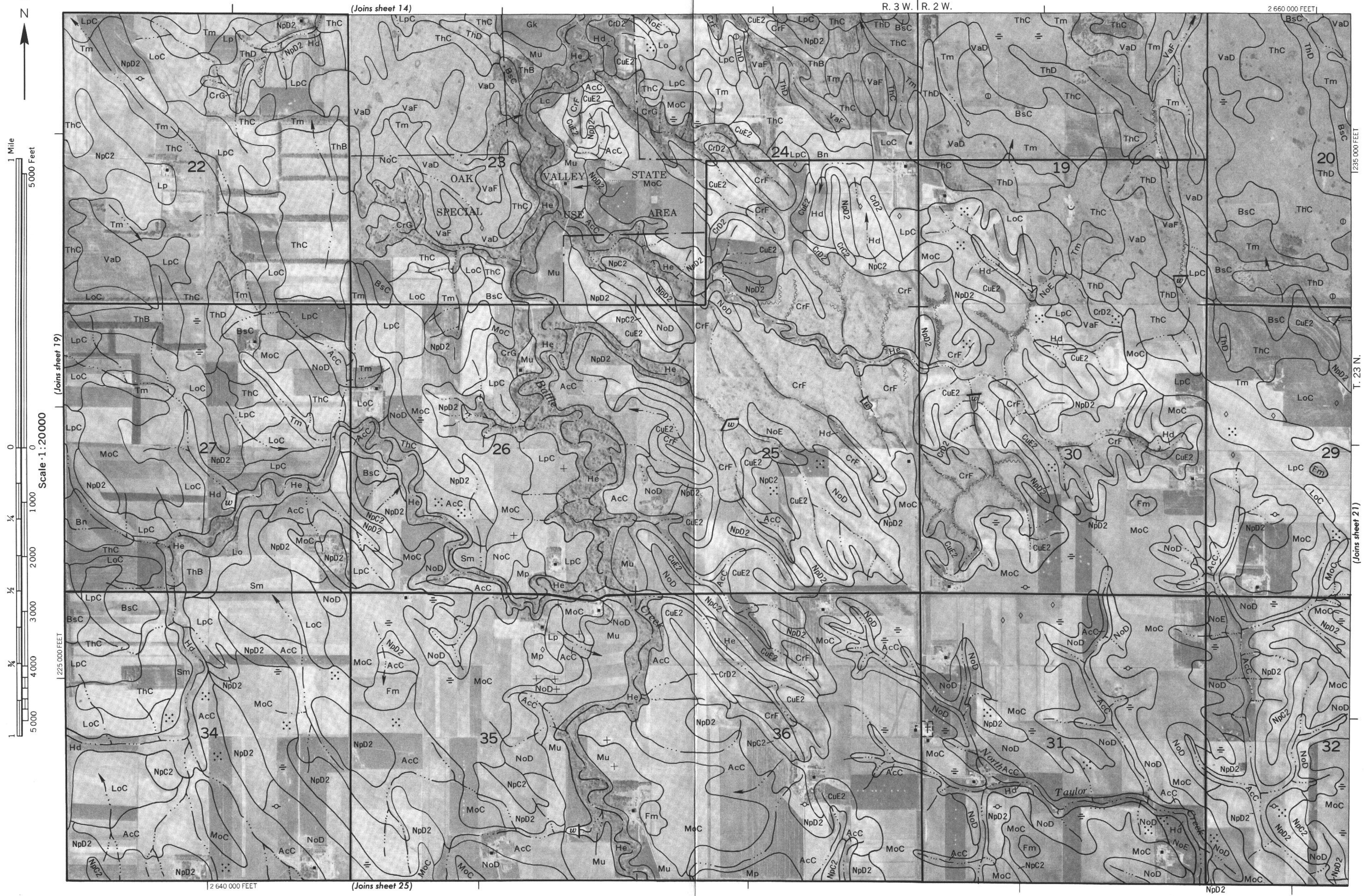


MADISON COUNTY, NEBRASKA NO. 19

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

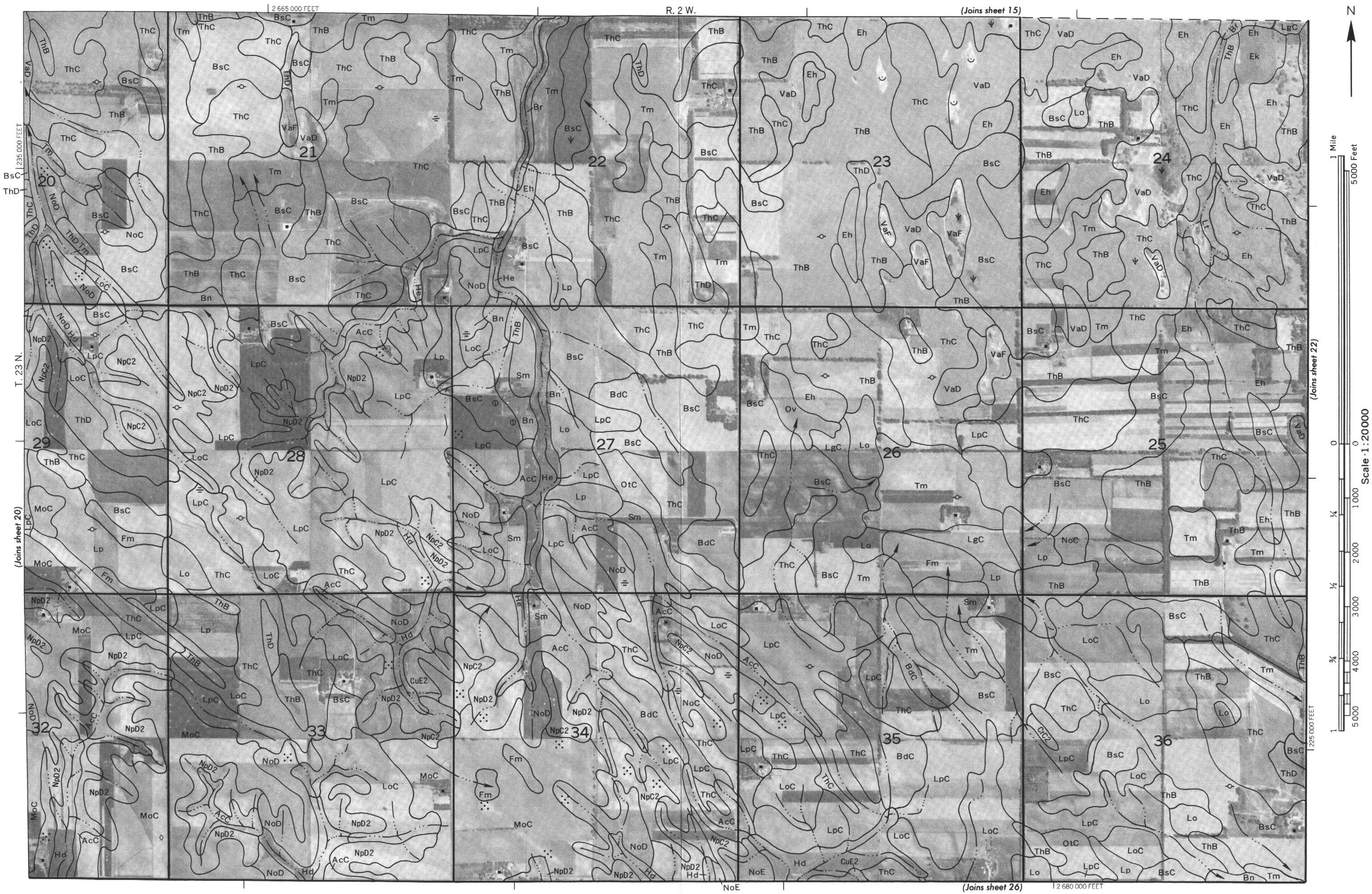
(20)

MADISON COUNTY, NEBRASKA — SHEET NUMBER 20



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA NO. 20



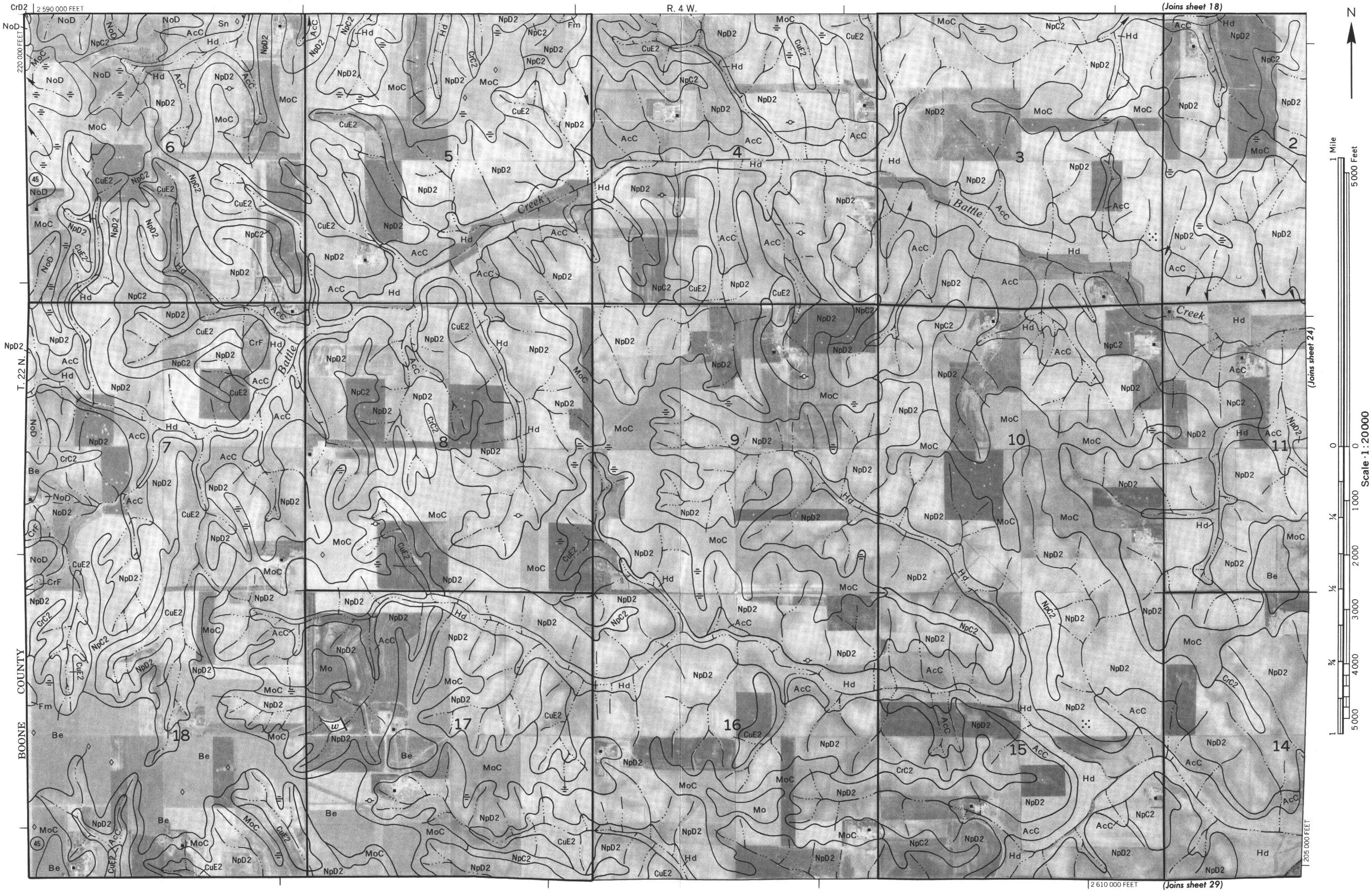
MADISON COUNTY, NEBRASKA NO. 21

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

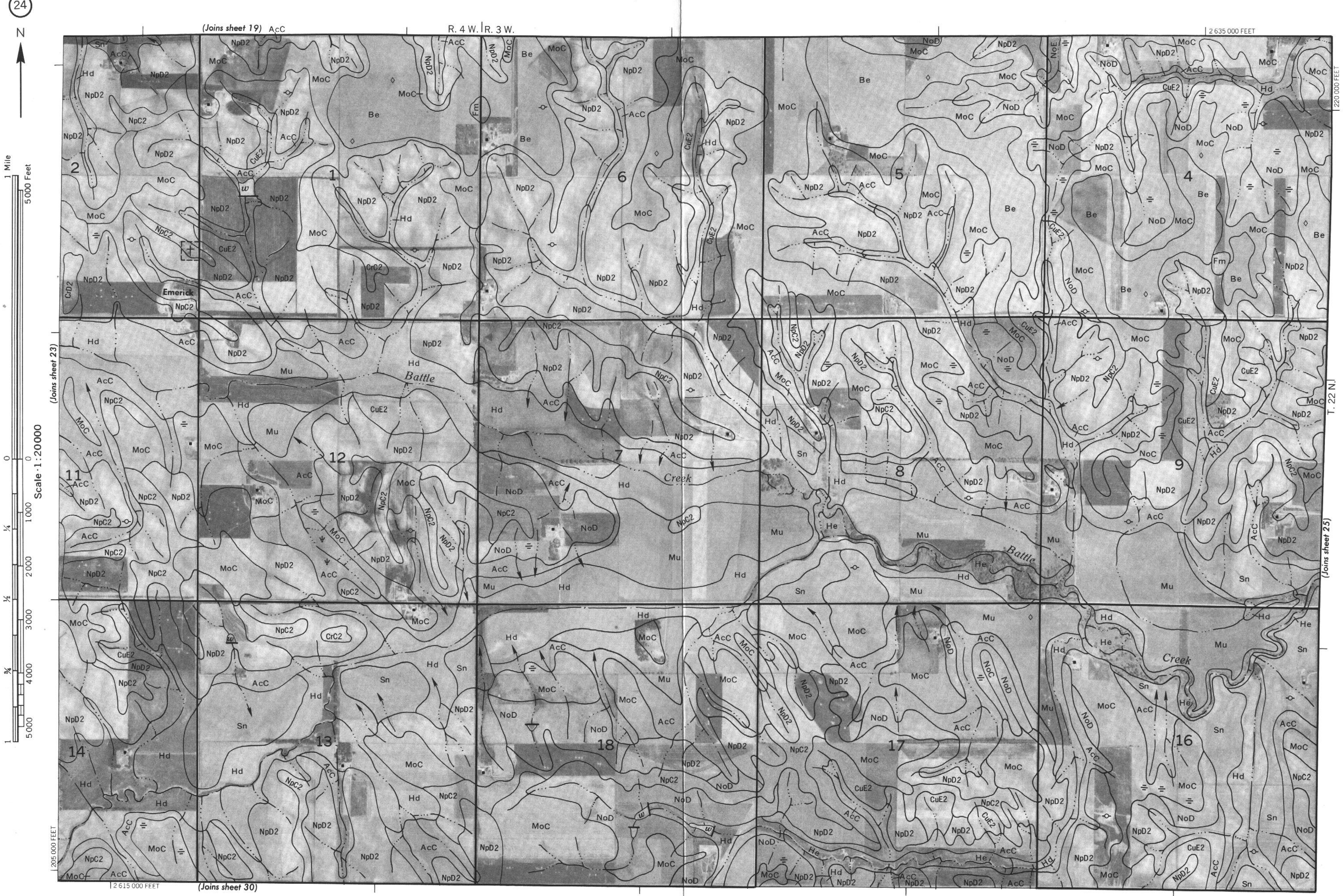
MADISON COUNTY, NEBRASKA — SHEET NUMBER 22

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA NO. 22

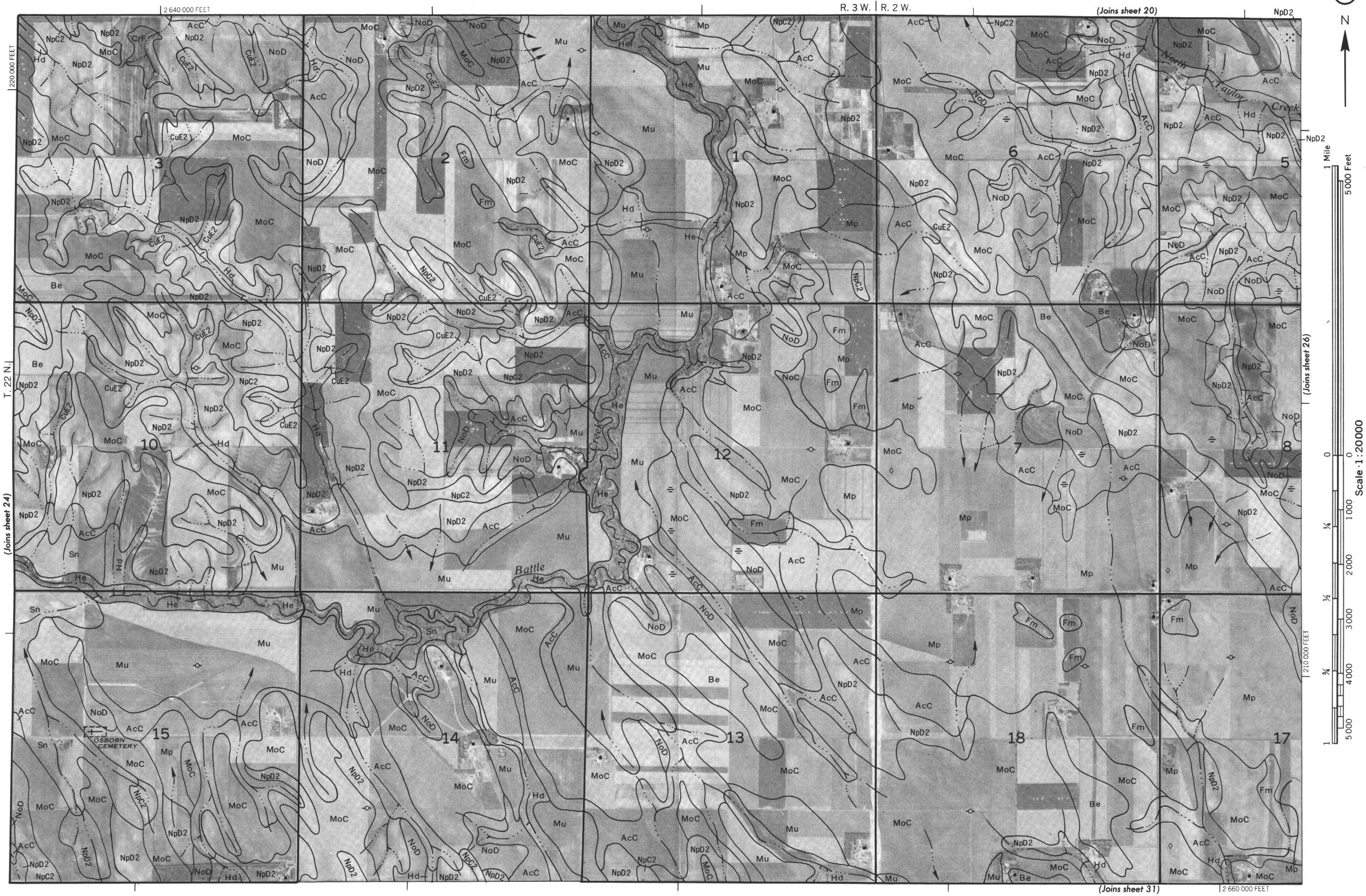


This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



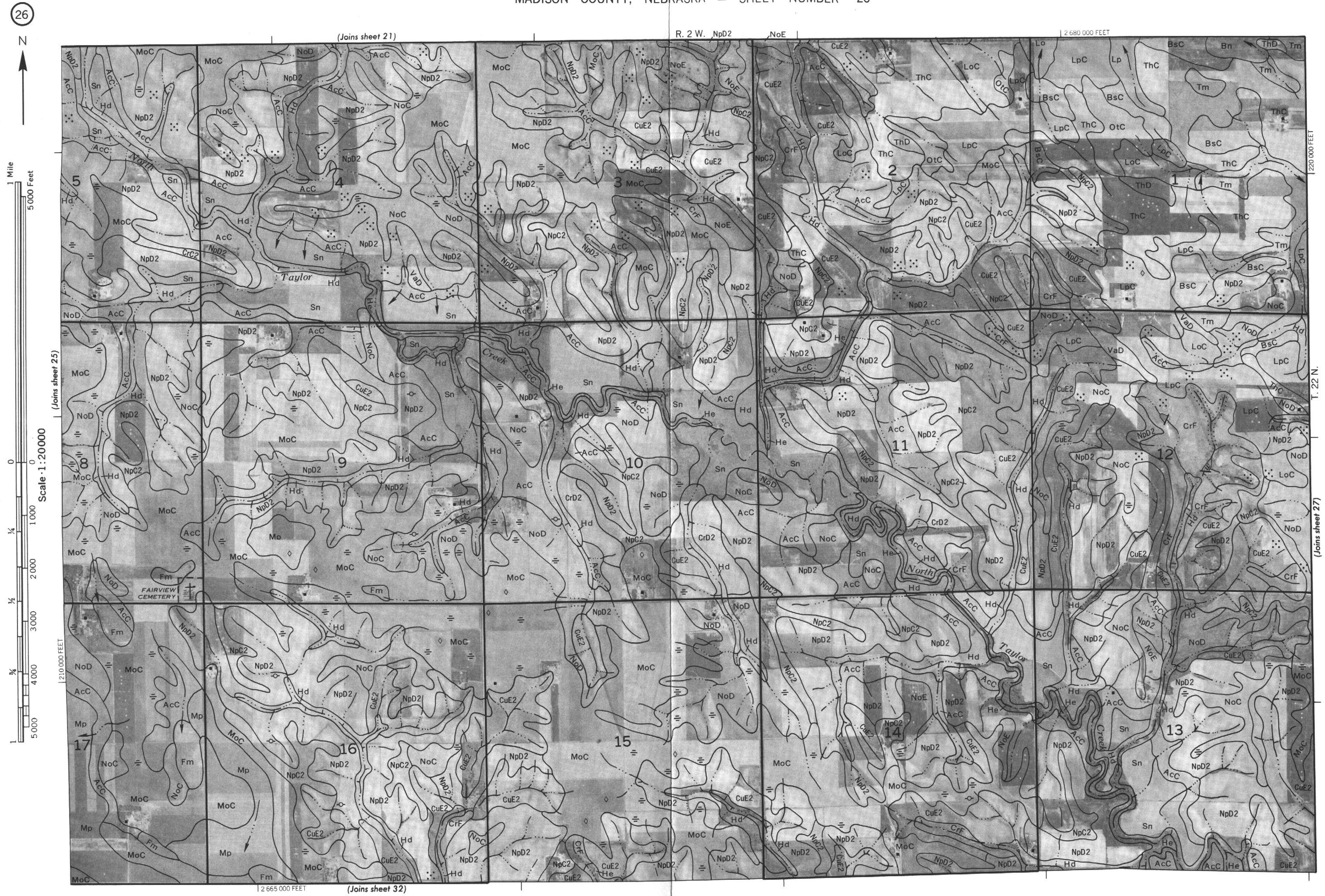
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA NO. 24



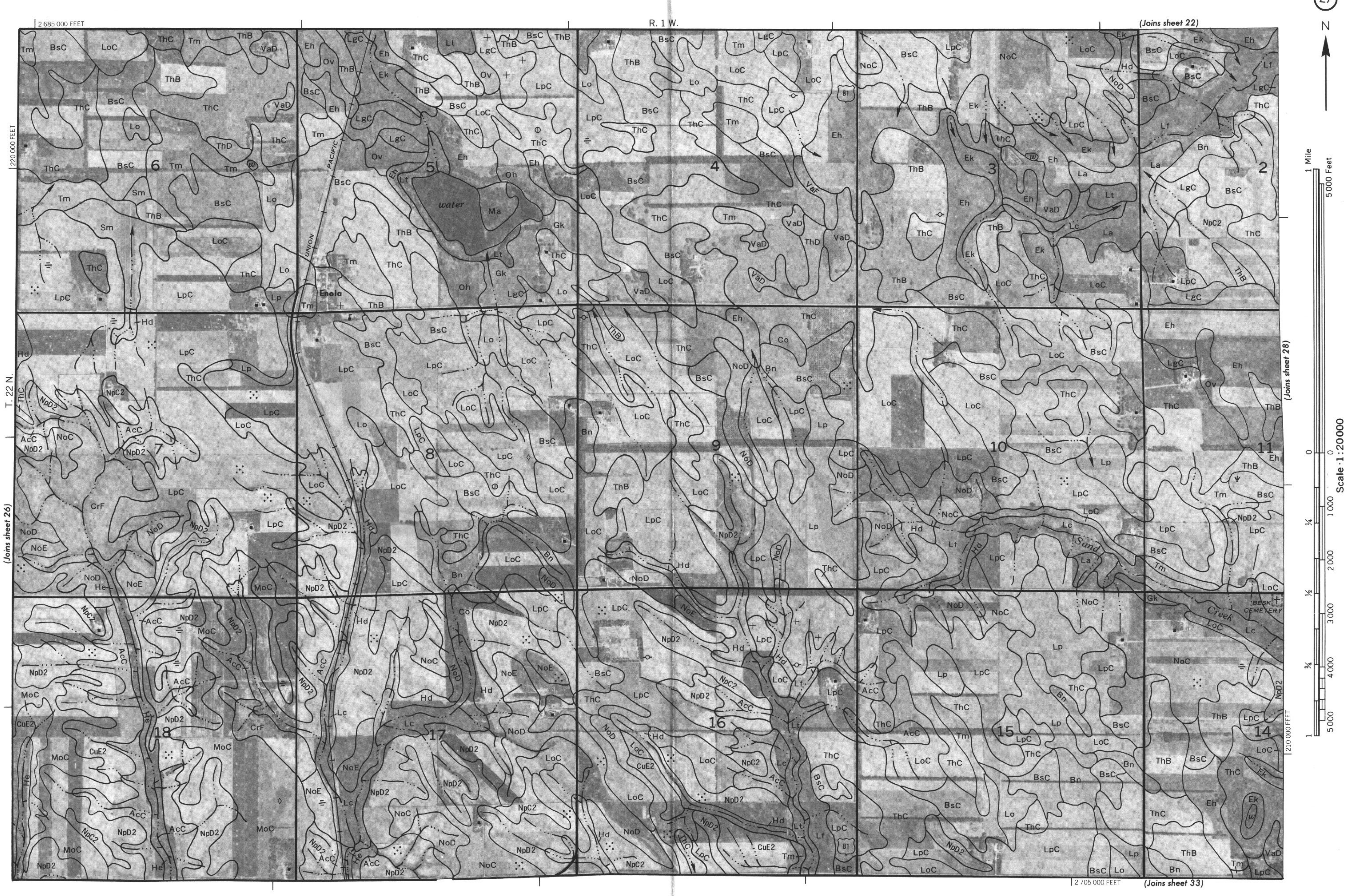
MADISON COUNTY, NEBRASKA NO. 25

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



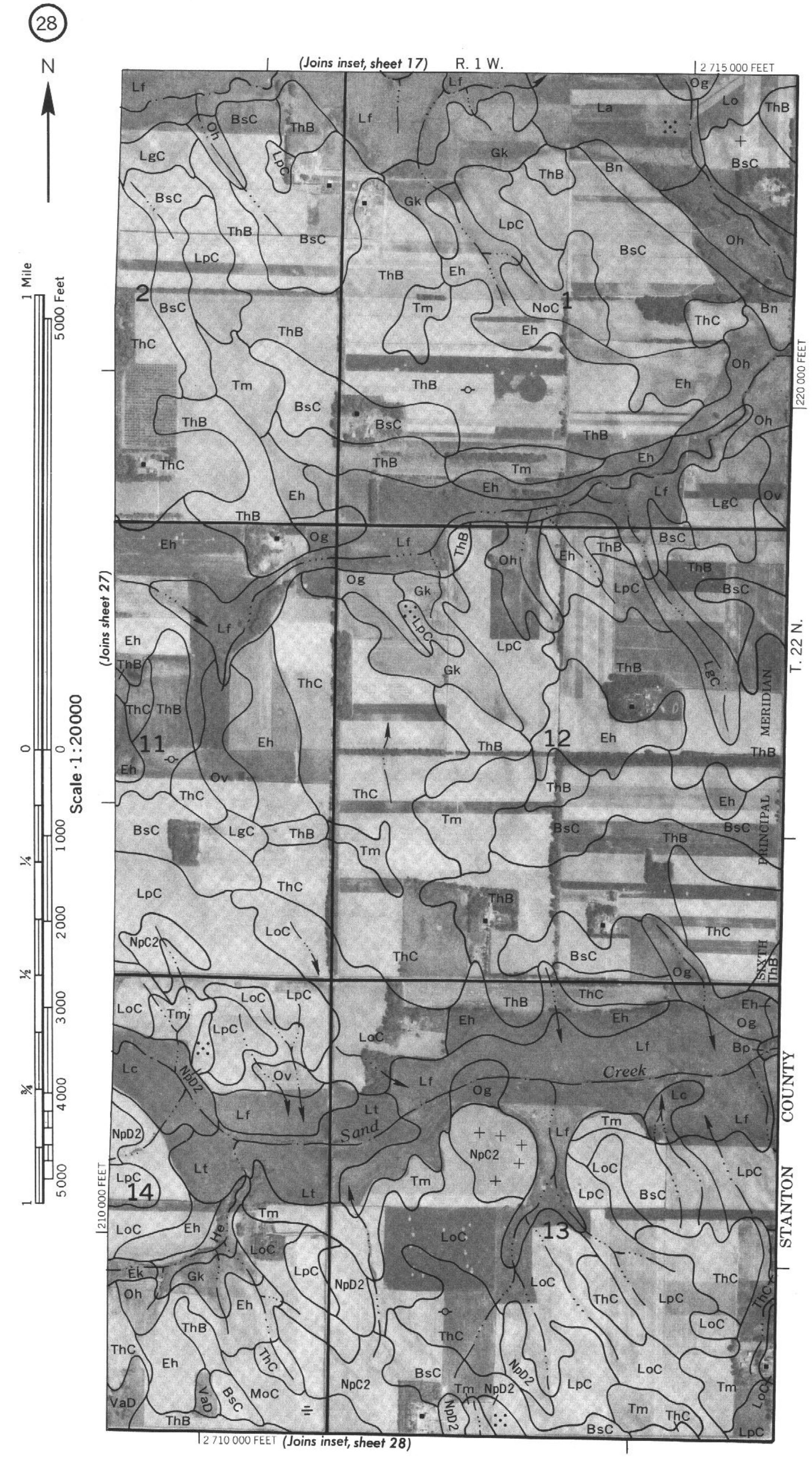
MADISON COUNTY, NEBRASKA NO. 26

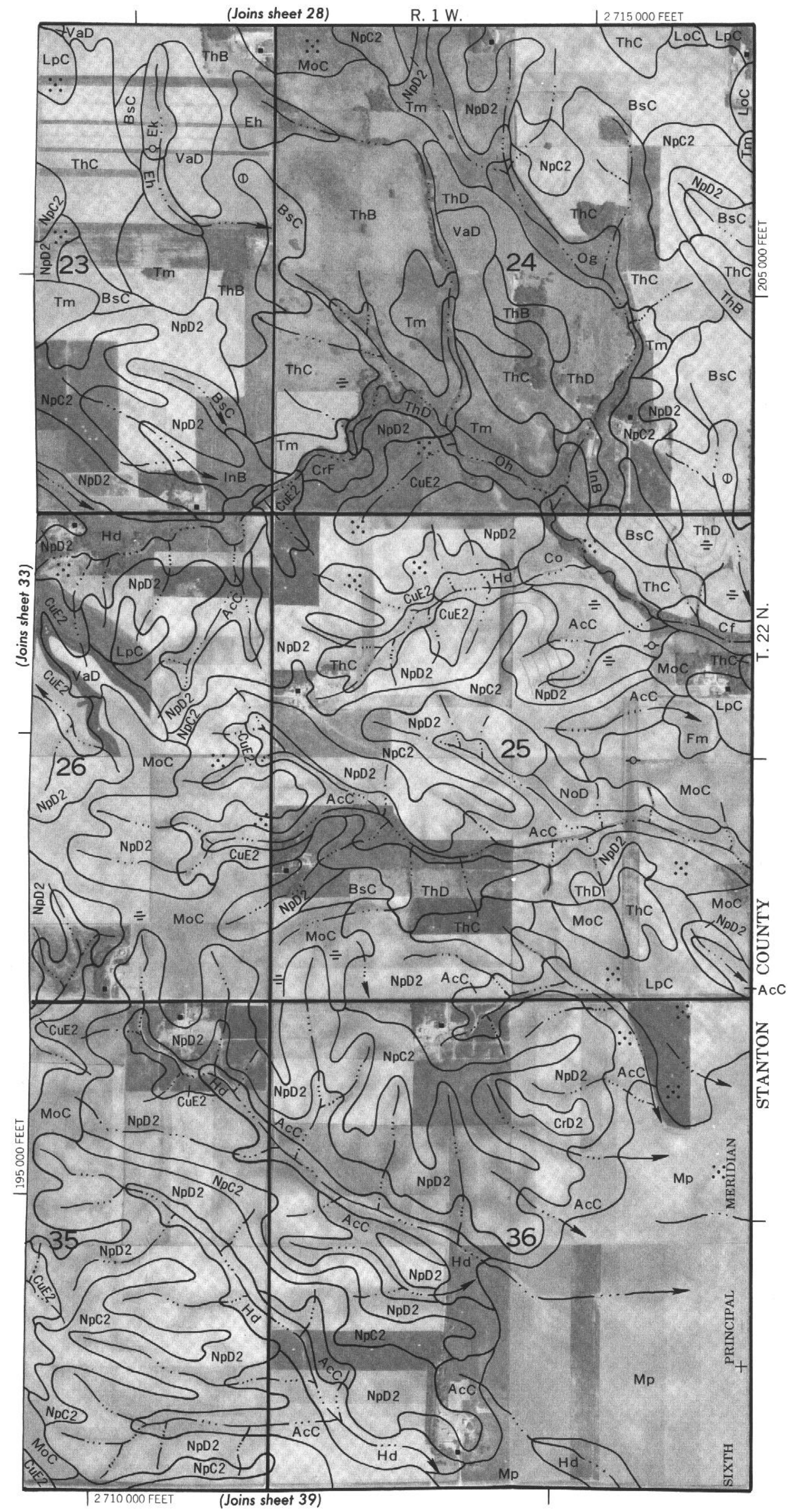
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



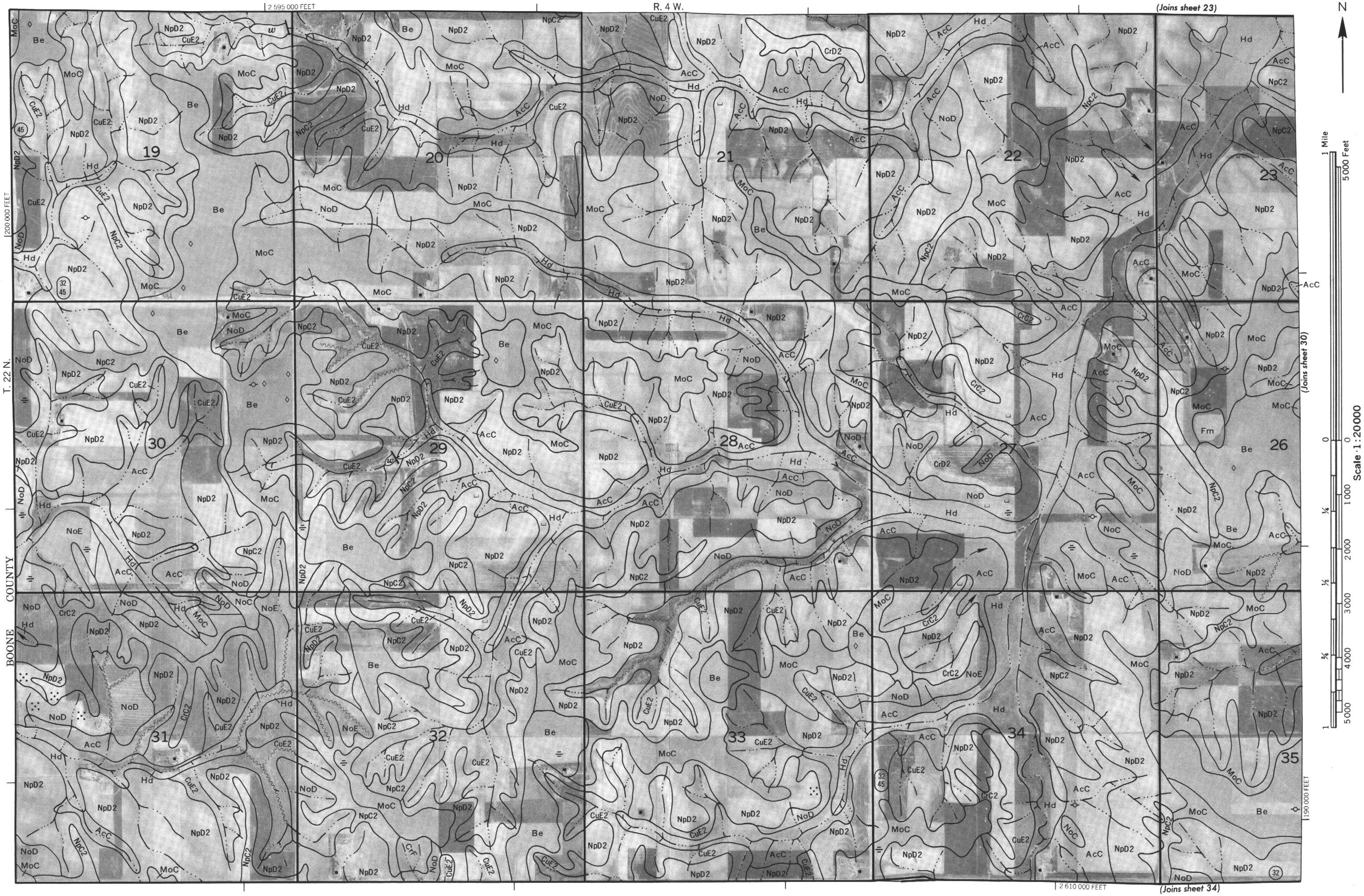
MADISON COUNTY, NEBRASKA NO. 27

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





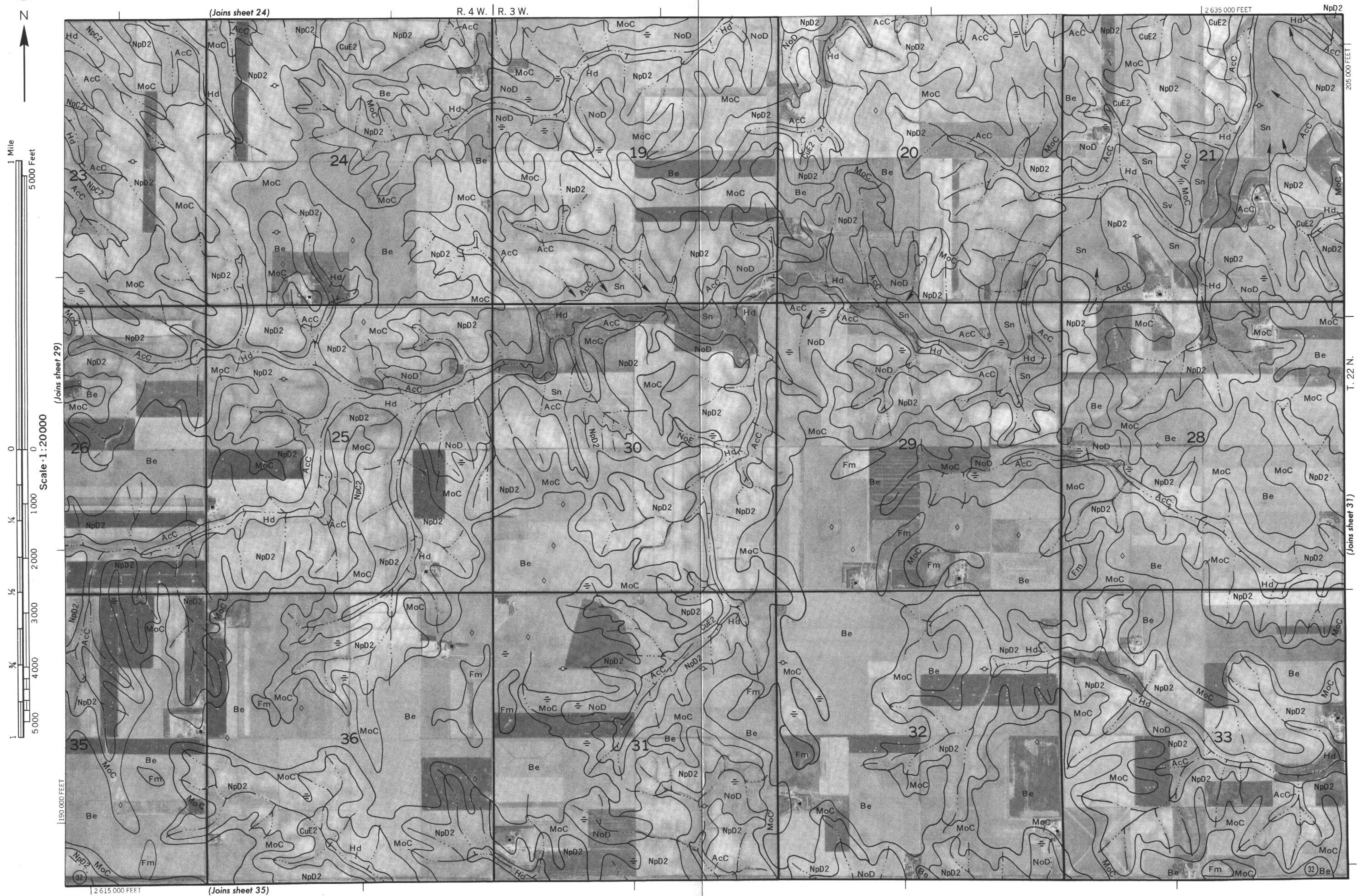
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



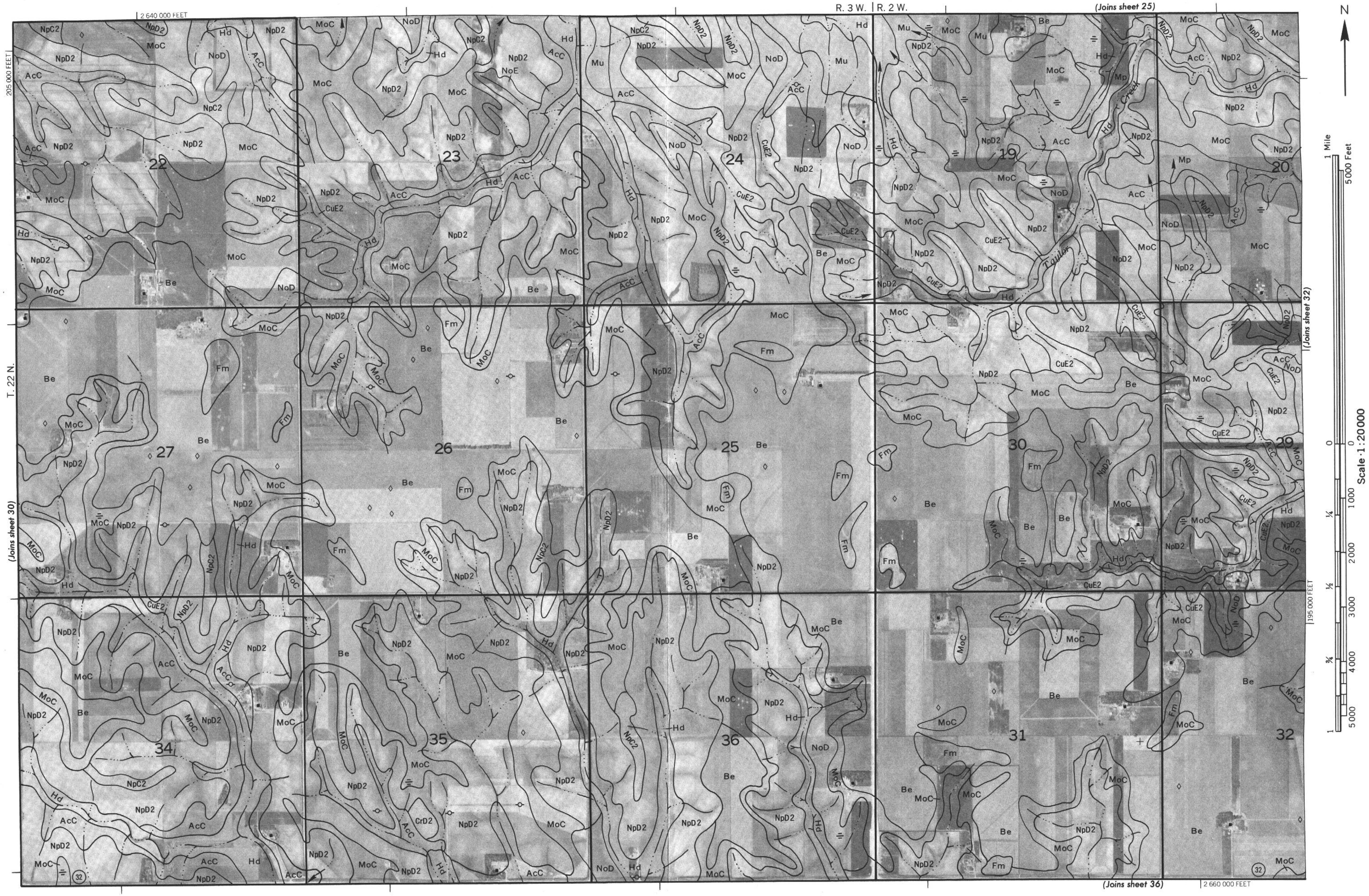
MADISON COUNTY, NEBRASKA NO. 29

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA — SHEET NUMBER 30



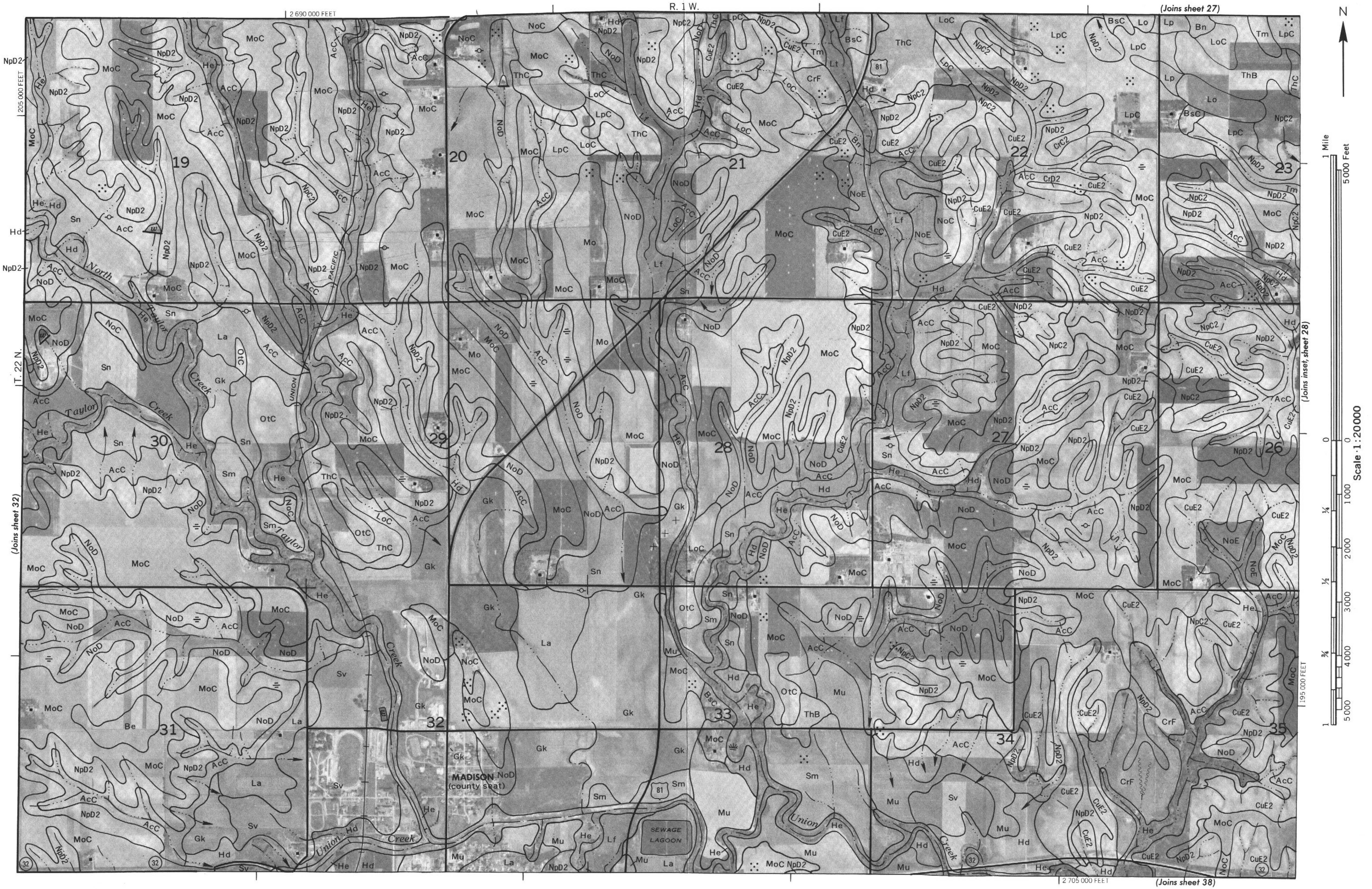
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



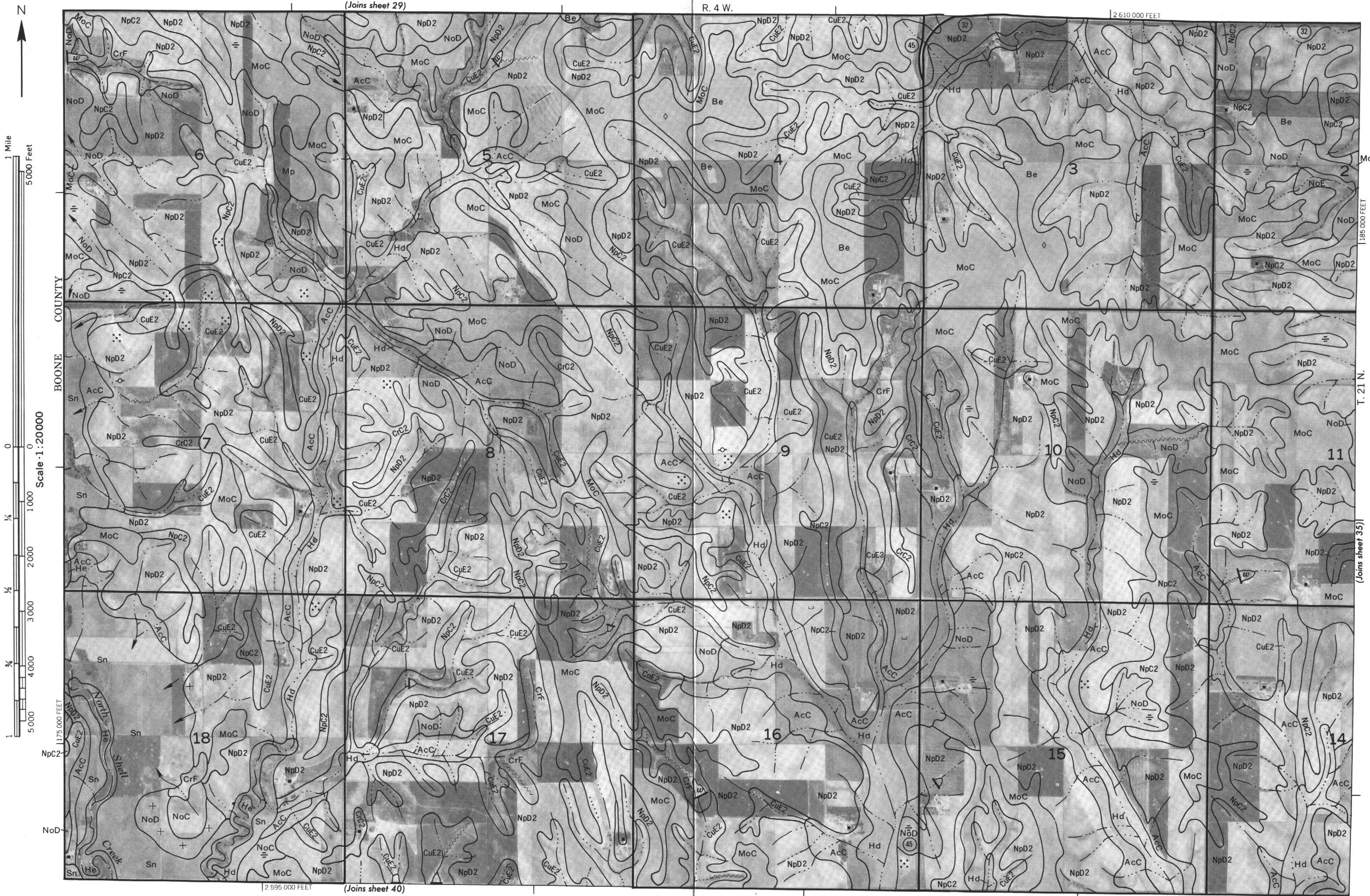
MADISON COUNTY, NEBRASKA NO. 31

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

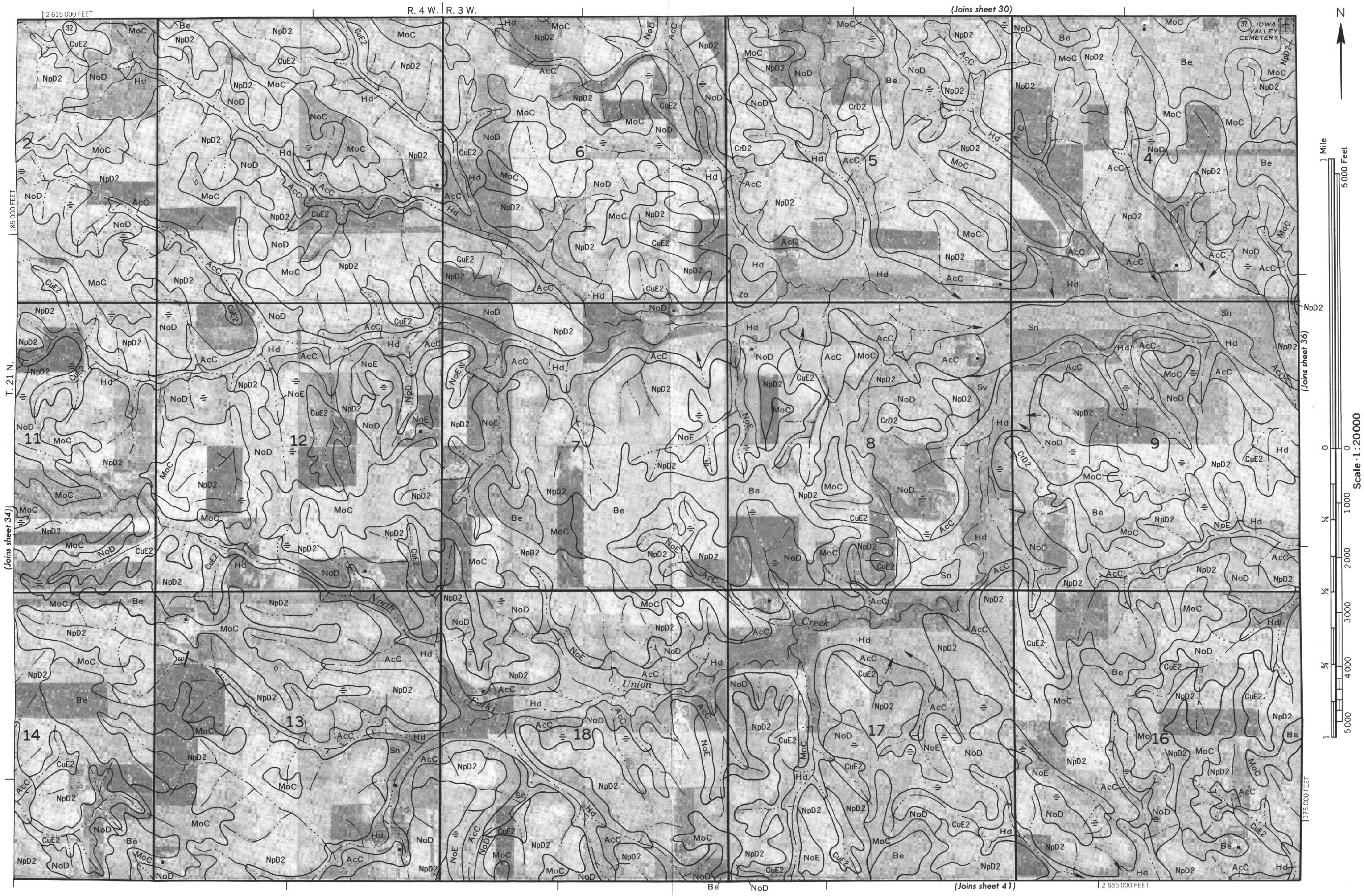


This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

35



MADISON COUNTY, NEBRASKA NO. 35

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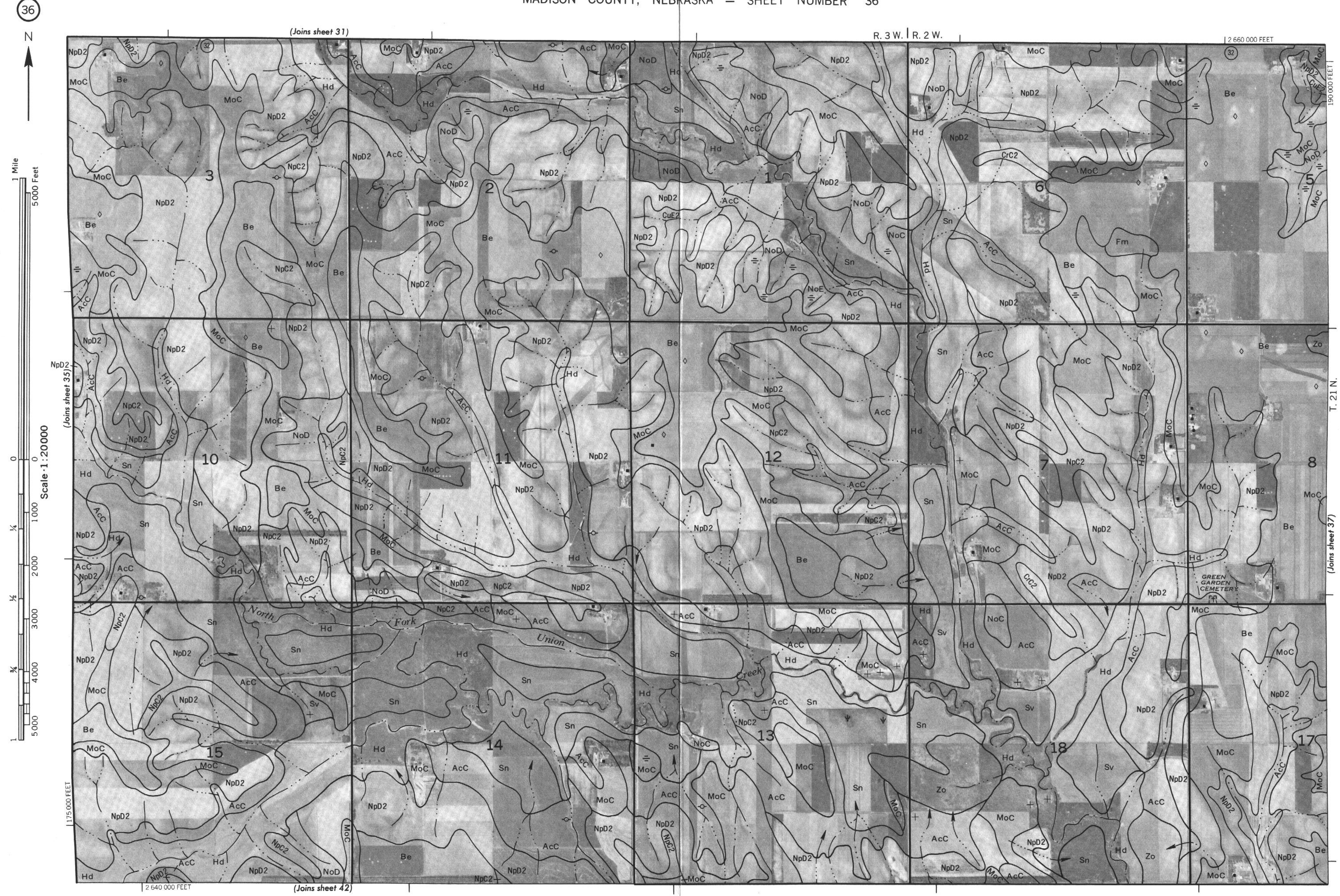
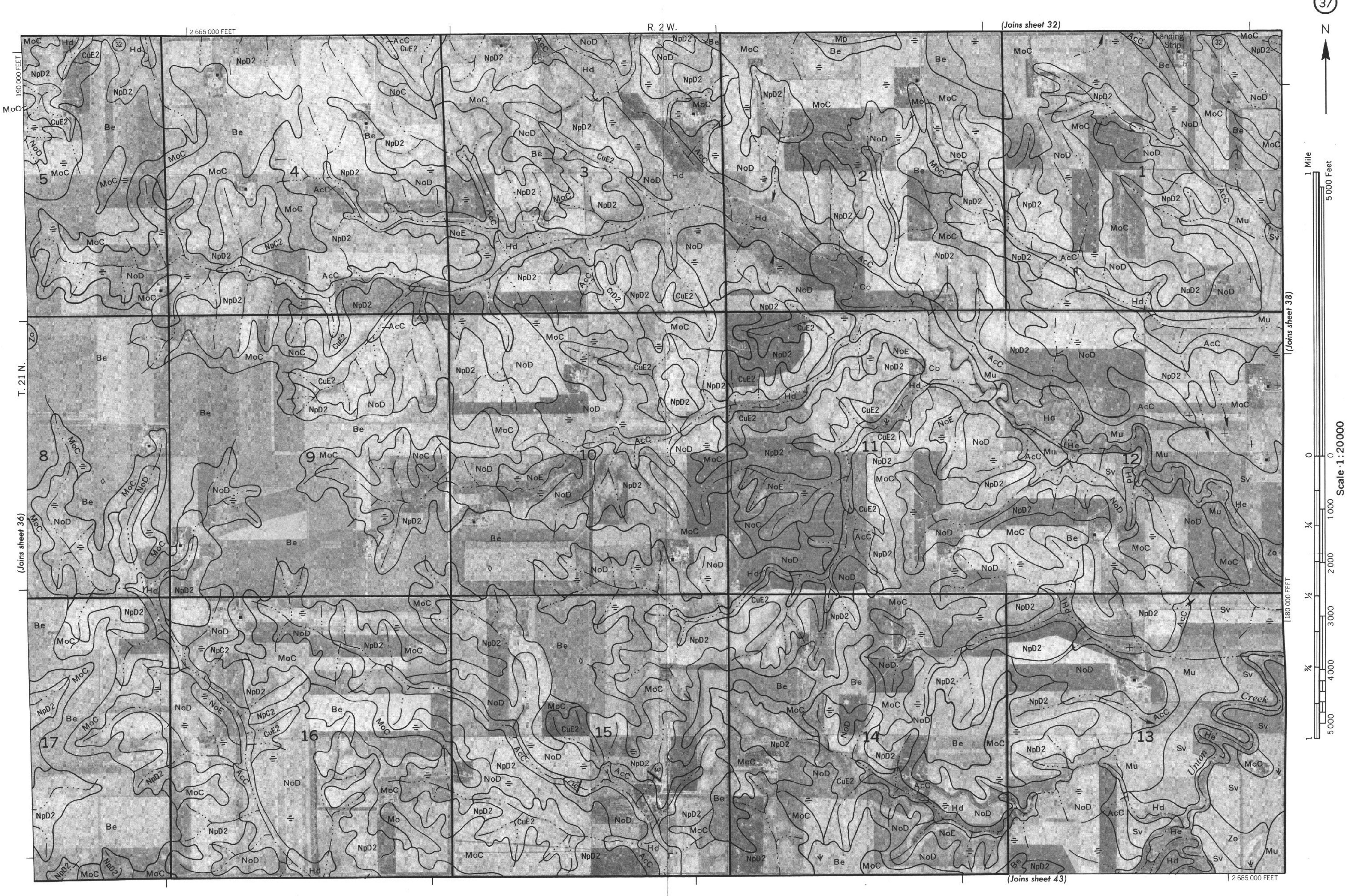
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



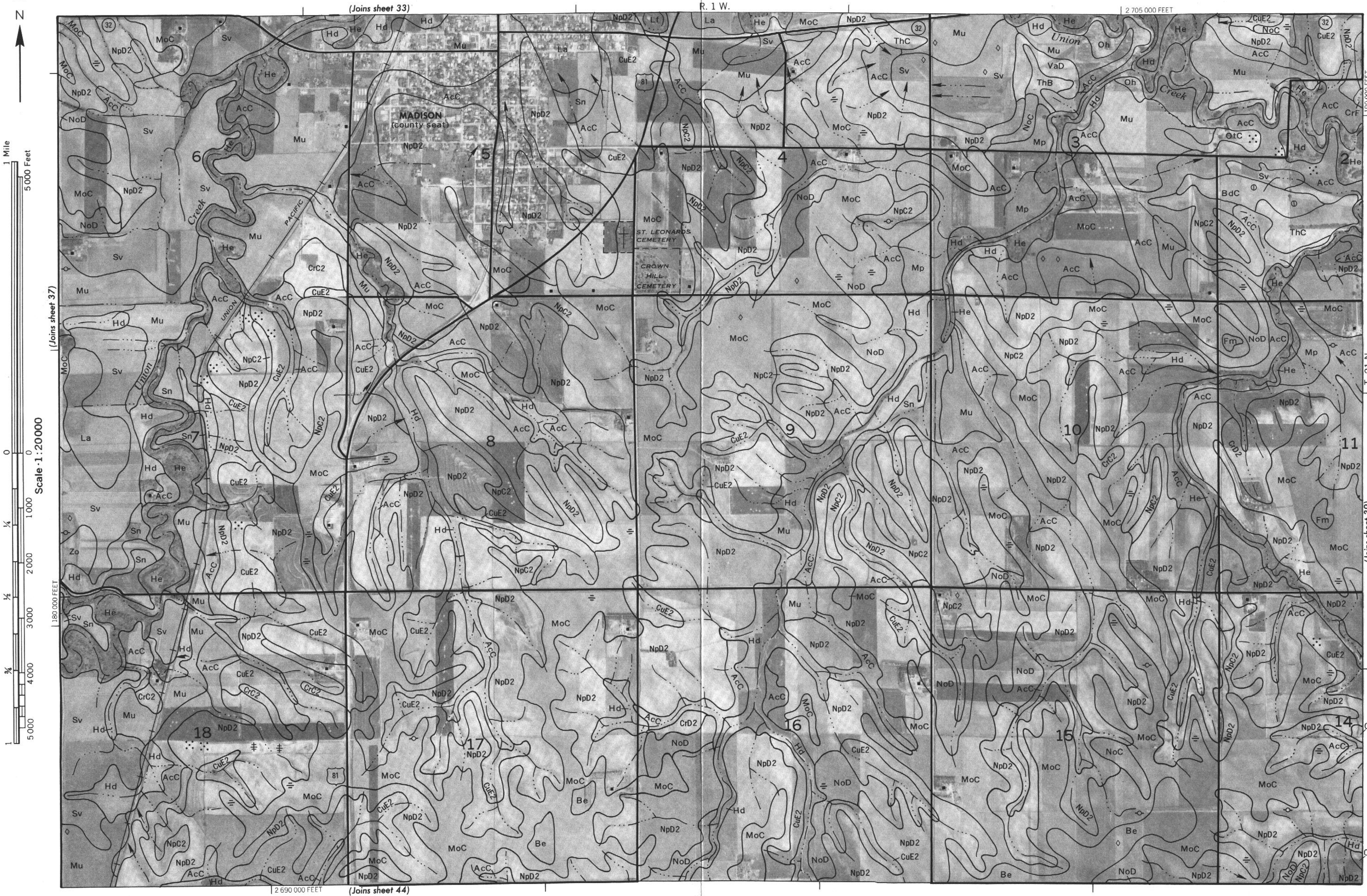
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA NO. 36



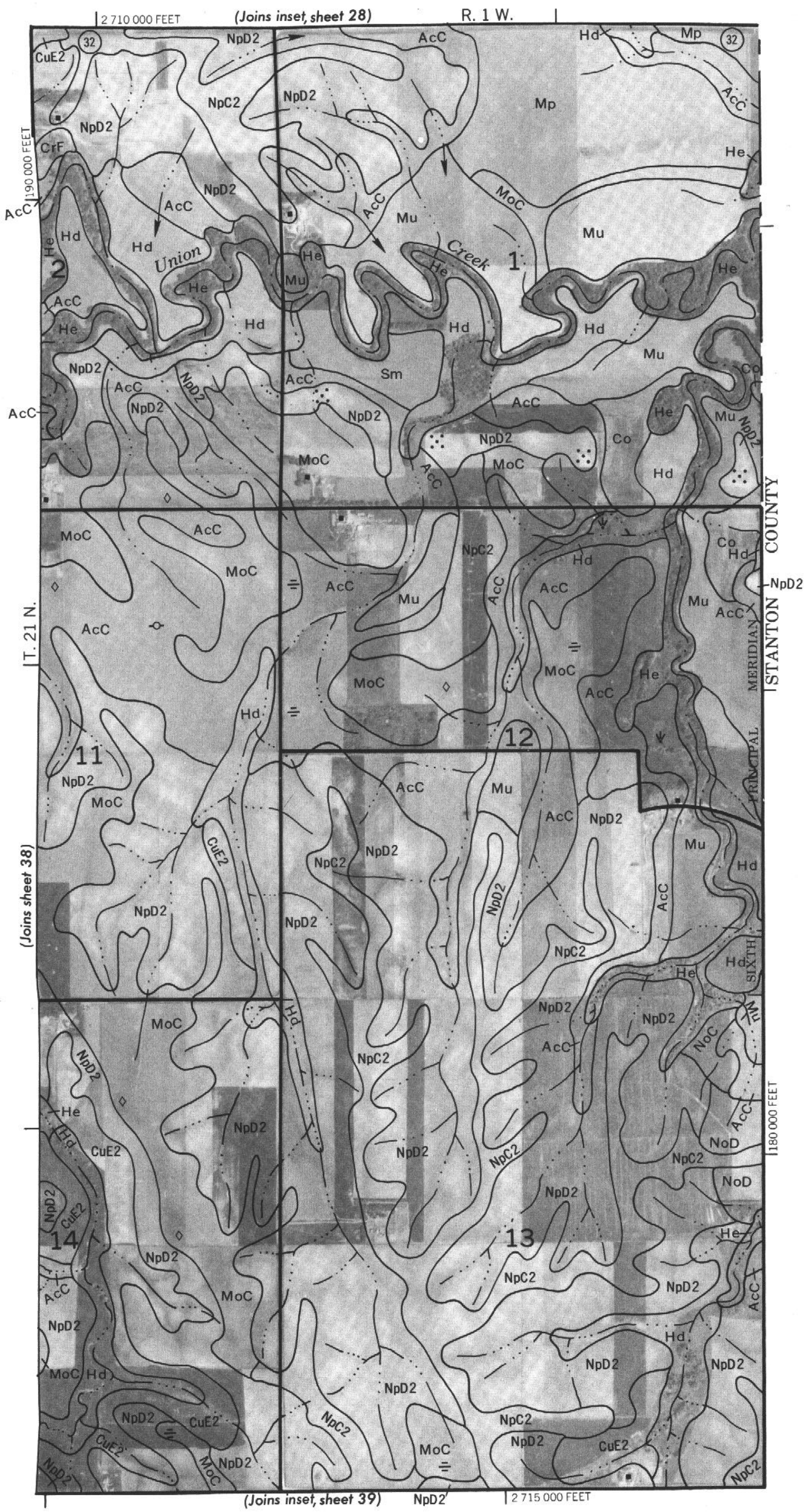
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

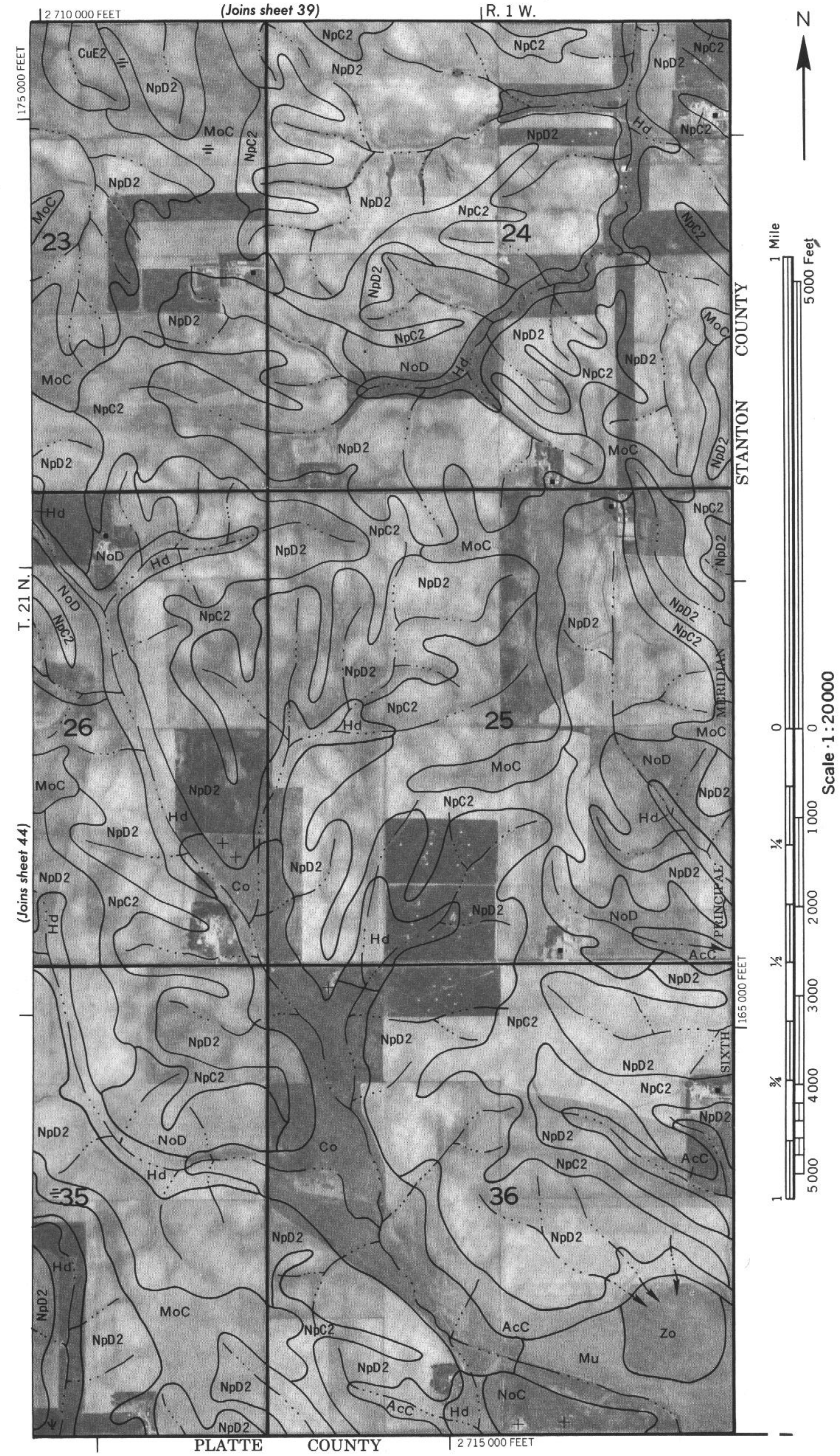
MADISON COUNTY, NEBRASKA — SHEET NUMBER 38



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA NO. 38

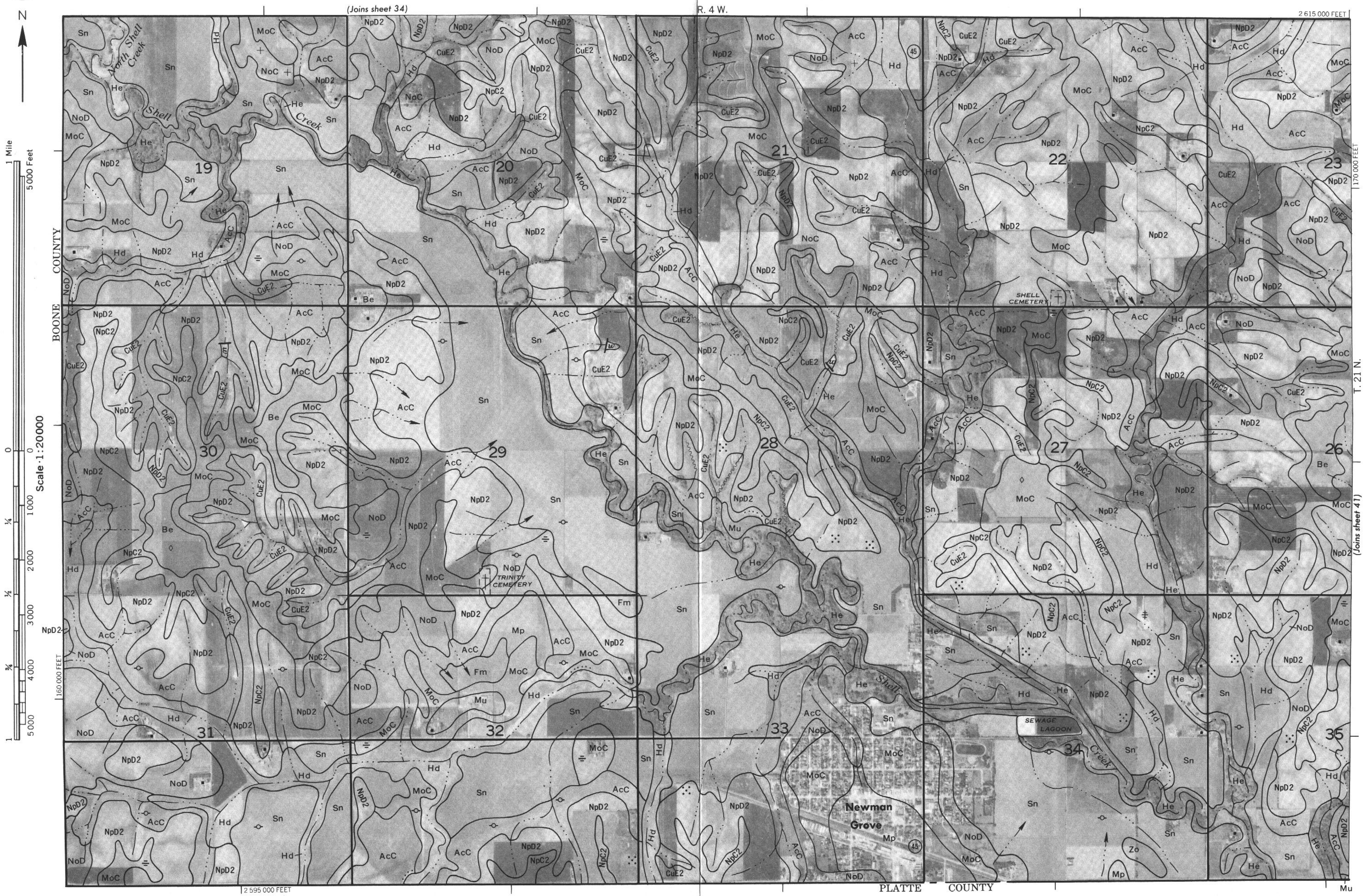




MADISON COUNTY, NEBRASKA NO. 39

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

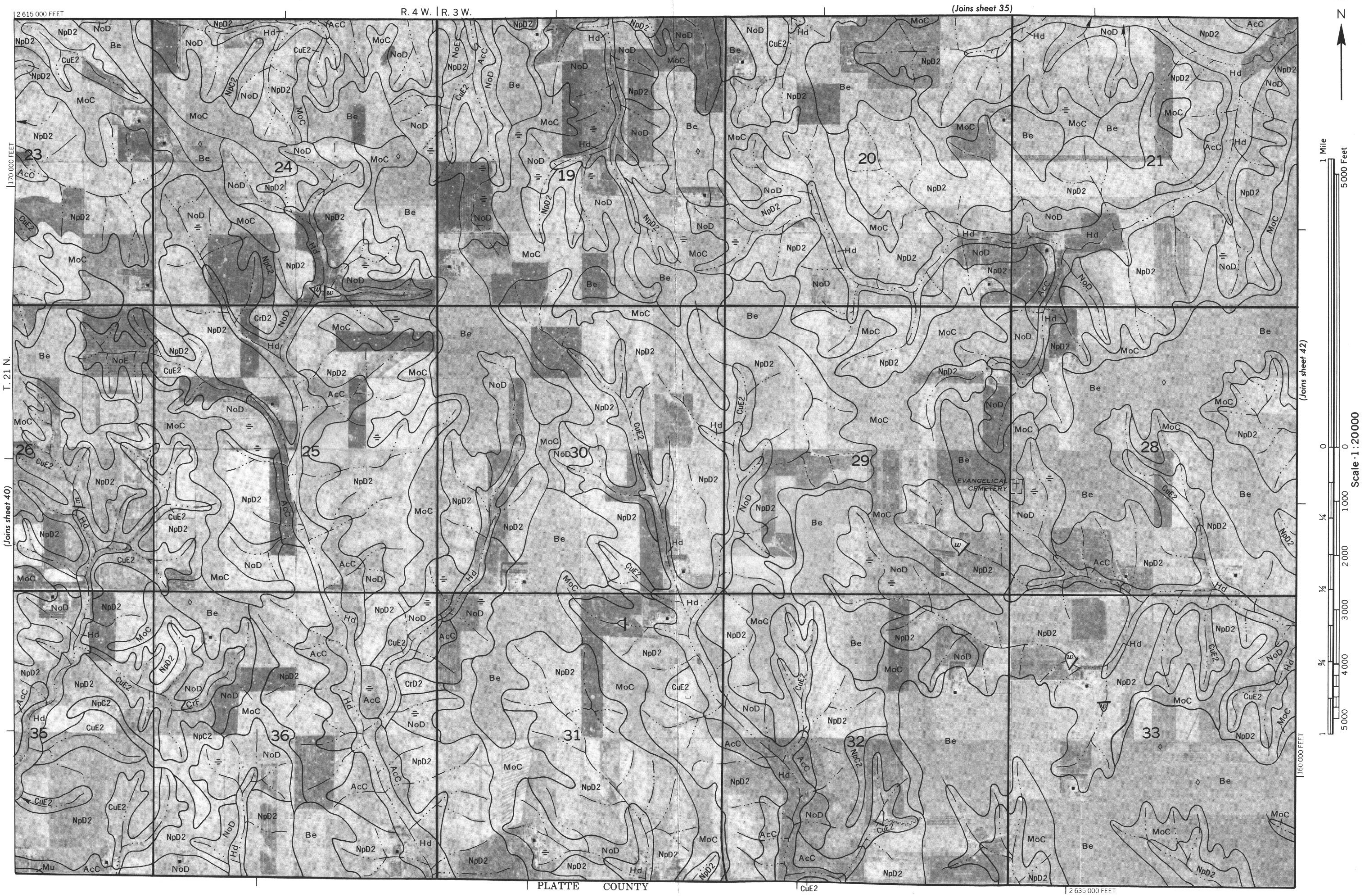
MADISON COUNTY, NEBRASKA — SHEET NUMBER 40



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

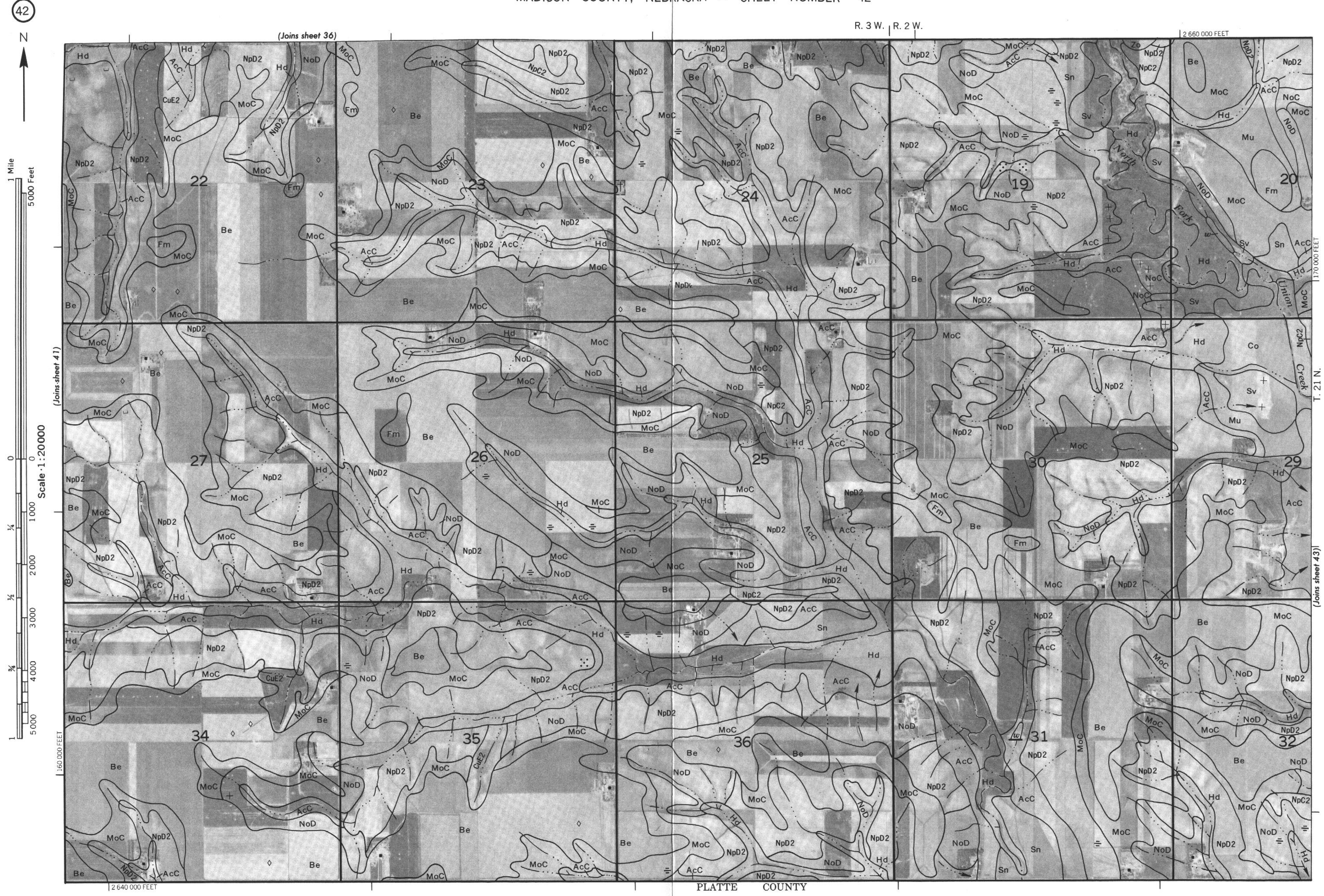
MADISON COUNTY, NEBRASKA NO. 40

MADISON COUNTY, NEBRASKA — SHEET NUMBER 41

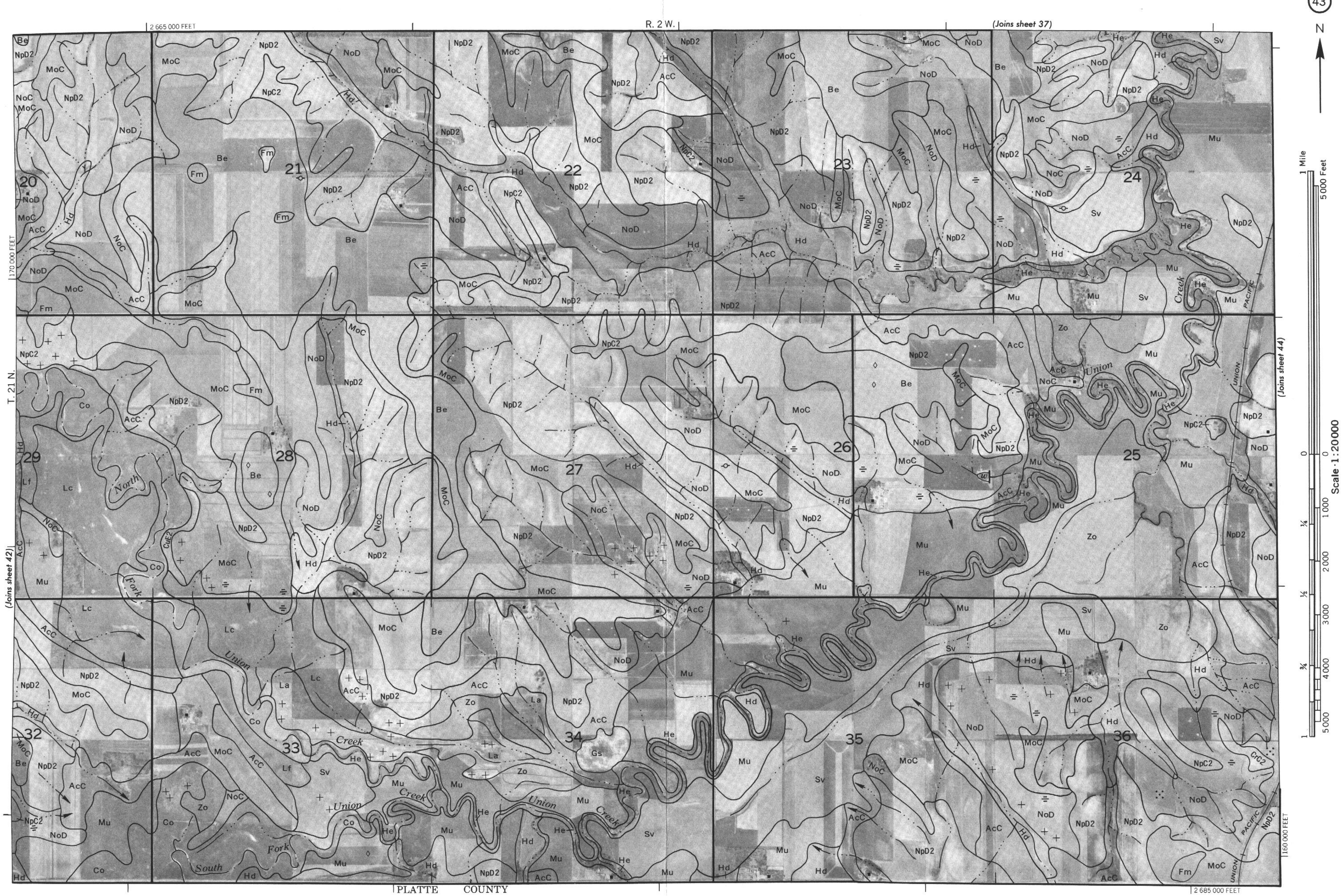


MADISON COUNTY, NEBRASKA NO. 41

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



MADISON COUNTY, NEBRASKA NO. 43
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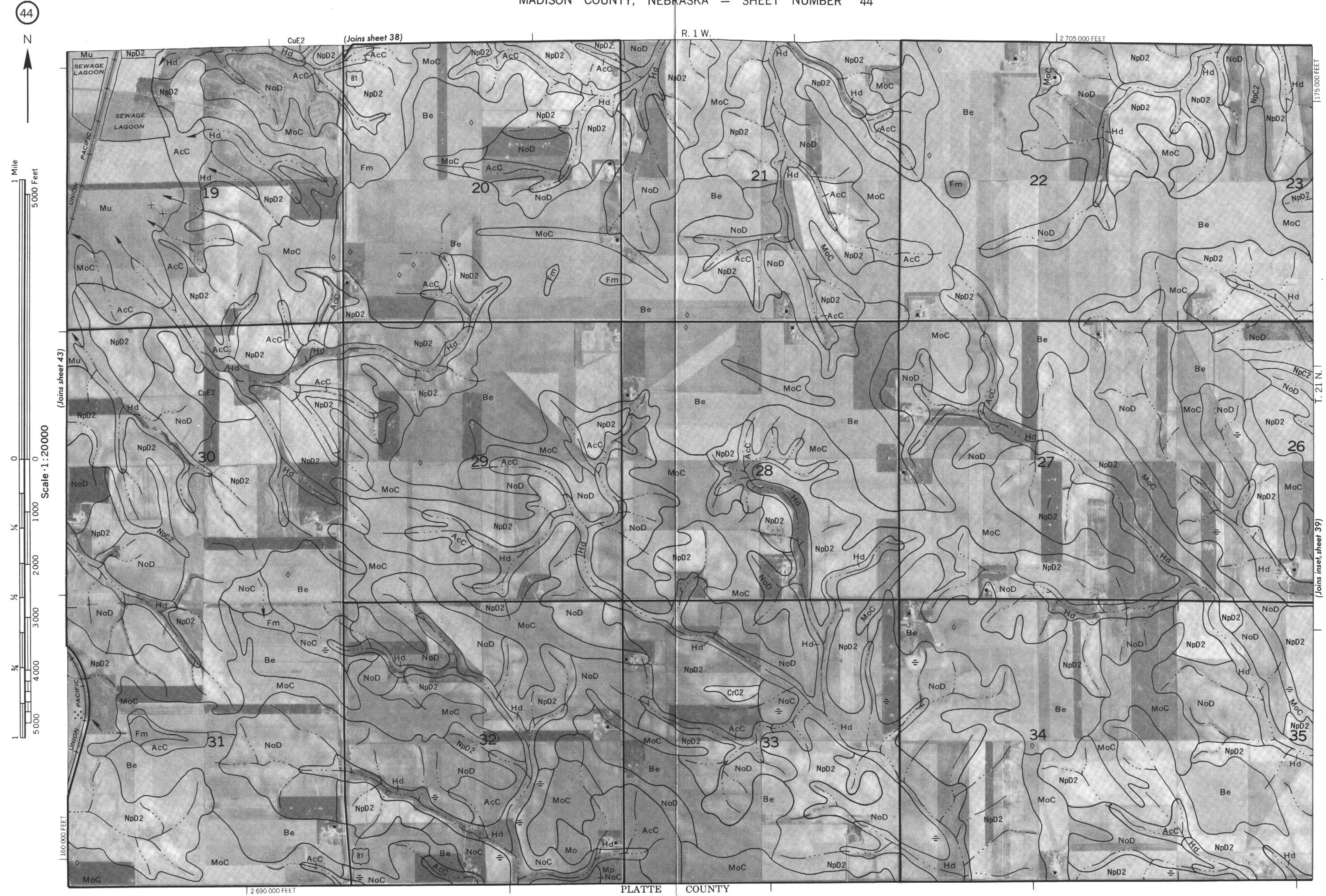
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

MADISON COUNTY, NEBRASKA NO. 44